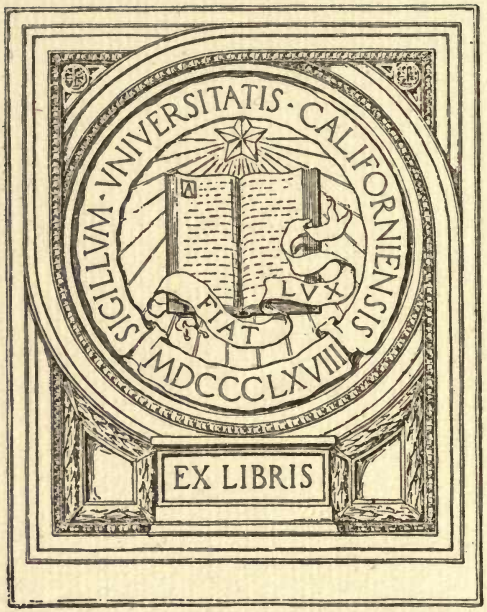
MUCK CROPS

UC-NRLF
B 3 146 596

ALBERT E. WILKINSON


SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
LVX
FIAT
MDCCCLXVIII
EX LIBRIS

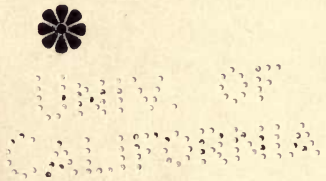
MUCK CROPS

A book on vegetable crops, raised on reclaimed land, in some localities known as black dirt or muck

By

ALBERT E. WILKINSON

New York State College of Agriculture



ILLUSTRATED

NEW YORK

ORANGE JUDD COMPANY

1916

SB321
W7

Copyright, 1916, by
ORANGE JUDD COMPANY
All Rights Reserved

PRINTED IN THE U. S. A.

PREFACE

During the last 30 years, the importance of muck crops has steadily grown until today probably more interest is taken in this group of soils and the crops grown thereon than in other lines of agriculture. Large companies have drained the swamps and are now offering the land for sale at seemingly high prices. Many men are making large amounts of money from these crops. It, therefore, seemed fitting that a collection of the most modern practices regarding the crops should be available. The author hopes that he has been able to set forth these requirements. The work is drawn from the experience of practical men in the field and from the experienc of the author in growing most of the crops mentioned.

Acknowledgment.—Credit is given to the Market Growers' Journal, Wisconsin Agricultural Experiment Station, credit for plans and illustrations, pages 42, 44, 51 and 55; Bulletin No. 229, Ohio Geological Survey Bulletin 16. Bulletins of U. S. Dept. of Agriculture. Reports of New York State Vegetable Growers' Association. Proceedings of New York State Drainage Association for valuable matter and suggestions obtained.

393730

INTRODUCTION

During the last 30 years, the importance of muck crops has steadily grown until today probably more interest is taken in this group of soils and the crops grown thereon than in other lines of agriculture. Large companies have drained the swamps and are now offering the land for sale at seemingly high prices. Many men are making large amounts of money from these crops. It, therefore, seemed fitting that a collection of the most modern practices regarding the crops should be available. The author hopes that he has been able to set forth these requirements. The work is drawn from the experience of practical men in the field and from the experience of the author in growing most of the crops mentioned.

CONTENTS

PAGE

CHAPTER I

WHAT IS MUCK? 1–14

How it is formed—Good versus poor muck —Stage of decay of muck—Shallow versus deep muck—Substratum—Water-holding capacity—Chemical contents—Muck-like substances.

CHAPTER II

WHERE IS IT FOUND? 15–19

Typical swamps—Average of unreclaimed and reclaimed swamps in the North Central States.

CHAPTER III

OF WHAT VALUE IS IT? 20–40

Its value as a fuel and for miscellaneous purposes—Muck as a fertilizer—Muck as a soil restorer and soil maker—Its value as a soil in which to grow crops—Crops that can be raised on muck.

CHAPTER IV

RECLAIMING MUCK LAND 41–76

Clearing—Drainage—Farmer may use the level—How to use the level—Source of water—Dig marshes and cost of main ditches—Getting the grade in the trench—Tile drainage—Examples of tile drainage and crops—Tile and cropping—Plowing—Muck shoes—Another method of working ground—Fitting the seed bed—Windbreaks —First crops.

CHAPTER V

ASPARAGUS 77–82

Requirements — Varieties — Seedlings —

PAGE

Planting—The natural position for the growth of the roots—Care following planting—Fertilizer—Harvesting and marketing —Yields, costs, and returns.

CHAPTER VI

BEETS 83–87

Garden — Requirements — Varieties — Preparing soil—Planting—Care of crop—Fertilizer — Harvesting — Marketing and yields—Cow beets or mangel wurzels—Requirements and culture.

CHAPTER VII

CABBAGE 88–96

Requirements — Varieties — Preparing the muck—Planting—Fertilizers—Care during the season—Insects and diseases—Harvesting and marketing—Yields, costs, and returns.

CHAPTER VIII

CARROTS 97–102

Requirements — Varieties—Preparing the muck — Planting — Fertilizers — Cultivation—Insects and diseases—Harvesting—Marketing—Storage—Yields, costs and returns.

CHAPTER IX

CAULIFLOWER 103–110

Requirements — Varieties — Seed — Growing and plants—Preparing and planting—Fertilizer—Cultivation—Insects and diseases — Harvesting — Marketing —Yields, costs and returns.

CHAPTER X

EARLY CELERY 111–141

Requirements—How to start the plants—Transplanting to field—Marking out the rows — Fertilizers — Cultivation — Mulching—Irrigation—Different forms—Diseases and spraying — Insects — Blanching — Harvesting and marketing—Cost of raising an acre.

PAGE

CHAPTER XI

LATE CELERY 142–156

Requirements—Growing the plants—Transplanting to the field—Planting—Fertilizer—Cultivation — Irrigation — Insects, diseases and spraying — Blanching — Harvesting — Storing—Cost to grow—A good celery farm.

CHAPTER XII

CORN 157–163

Requirements—Sweet corn—Remarks—Varieties—Seed—Preparing the soil—Planting — Fertilizer — Cultivation — Suckering —Insects and diseases—Harvesting and marketing—Yields and costs—Field corn —General requirements.

CHAPTER XIII

LETTUCE 164–178

Requirements—Varieties—Preparing land—Fertilizer — Planting — Cultivation — Thinning — Irrigation — Insects — Diseases—Harvesting and marketing—Shipping—Costs, yields and results.

CHAPTER XIV

MINT 179–183

Remarks—Preparing and planting—Fertilizer—Cultivation—Harvesting and distilling—Yields.

CHAPTER XV

ONIONS 184–207

Requirements — Varieties — Preparation of the land—Planting—Fertilizer—Cultivation — Weeding — Pulling — Topping — Stacking — Screening — Marketing — Storage — Costs — Yields — Insects — Diseases—Smut—Typical onion farm.

CHAPTER XVI

PEAS 208–217

Requirements — Varieties — Fertilizers —

PAGE

Preparing and planting—Cultivation—Harvesting — Cannery — Commercial — Yields—Insects—Diseases.

CHAPTER XVII

POTATOES 218–230

Requirements — Varieties — Seed — Preparing for planting—Planting—Fertilizers —Cultivation—Spraying—Harvesting, marketing—Yields and costs.

CHAPTER XVIII

SPINACH 231–241

Requirements — Varieties — Preparing — Planting — Fertilizer — Cultivation — Pests—Harvesting and marketing—Costs and yields—Remarks by grower.

CHAPTER XIX

MISCELLANEOUS CROPS 242–246

Remarks — Strawberries — Squash — Narcissi—Asters—Oats and other grains—Hay.

LIST OF ILLUSTRATIONS

	PAGE
Rear of a Dipper Ditching Dredge	3
A Bates Steel Mule Hauling Spinach	7
A Good Storehouse	12
Storage of Farms Co., Elba, N. Y.	17
Cutting Spinach	21
Yellow Danvers Onion 900 Bushels per Acre	26
Spreading Lime	30
First Crop Celery	38
Tools for Tile Working	42
Tile System with 2 Mains	44
Line of Levels	47
Tile System	51
Tile System	55
Planking	59
Planking Side View	61
Roller and Mulcher	64
Fitting Land	70
Deep Tilling Disc Plow	73
Muck Tools	78
More Tools	81
Table Beets	84
Planting Cabbage	91
One Row Marker	97
Extra Choice Head Cauliflower	105
Three Row Marker	109
Greenhouse for Celery	112
Greenhouse for Celery	113
Cold Frame for Celery	114
Seed Bed Yard	116
Roller Used for Marking	118

	PAGE
Cultivating Celery	122
Early Celery	123
Celery and Onions	126
Celery and Irrigation	128
Growing Celery (Early) under Canvas	131
Paper Blanching	133
Paper Blanching	135
Sample Stalks of Celery	137
Harvesting and Crating	138
Canastota Basket	139
Celery Harvester	140
Jennings Bros. Celery Marker	143
Side View of Celery Marker	143
Hilling Celery	145
Side View of Hillers	147
Single and Double Mould Board Hillers	148
Two Horse Hiller	149
Crates	151
Loading Car	152
Late Celery Banked	154
Extra Fancy Celery	158
Celery in Crates	160
Auto Truck, Sunset Farms	162
Companion Crops	167
A Fine "Stand" of Lettuce	173
Lettuce and Celery	176
Large Field of Onions	181
Growing Onion Seed	184
Drying Seed Balls	186
Three Row Onions Planted (Front)	188
Three Row Onions Planted (Rear)	189
One Row Planter and Sulphur Attachment	190
Weeding Onions	192
Onions Drying After Pulling	193
Topping by Hand	194
Onions in Crates	196
Full Crate of Onions	198

PAGE

Onions in Stacks 199
Screening 201
Power Onion Topper 203
Small Onion Topper 205
Onion Storehouse 207
Roller to Firm Muck After Planting . . . 210
Load of Onion Crates 212
Companion Crops—Onions and Celery . . . 215
Thick "Stand" of Onions 220
Tractor Hauling Potatoes 224
Spinach 5 Weeks Old 228
Spinach Just Beginning to Grow 232
Spinach Ready to Harvest 234
Harvesting Spinach 237
Squashes 243

MUCK CROPS

CHAPTER I

WHAT IS MUCK?

In many states are found low bodies of land which are generally swampy and often spoken of as being "peaty or mucky," a name commonly given to the soft, woody, black soil found in these places.

How it is Formed.—These soils result from centuries of accumulation of discarded and dead plants which have been subjected to excessive moisture and thereby hindered in their natural decay. Many of these muck deposits were formerly lakes, ponds, or even abandoned channels of rivers or smaller streams. Commonly, in many cases, these lakes or ponds were created by the great masses of ice which once covered the region. The ice frequently left the surface of the land pitted, a common situation of muck deposits in the States of New York, Michigan, Ohio, Wisconsin, Indiana, Minnesota, in Canada and other places.

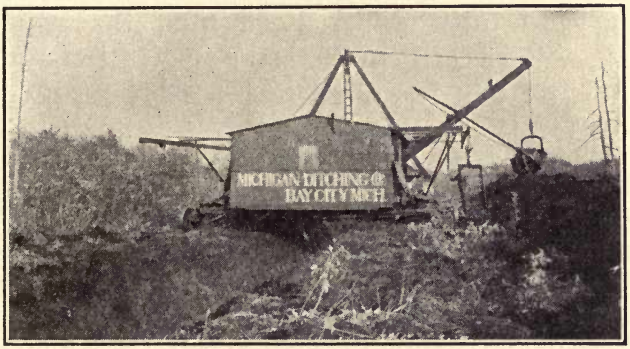
Probably most of these deposits were lakes at one time, on the shores of which plants began to grow, on death sinking to the bottom. A succession of muck-forming plants can be recognized from the free floating forms at the edge of the open water through grass plants to tree forms. Gradually the plant border extends and thickens until the lake is filled, and not infrequently evidence is produced that under muck beds sufficiently thick to permit cultivation free water is found.

Sometimes large lakes have been drained naturally, thus bringing about conditions which are favorable to muck formation. Good examples of the latter are the Oak Orchard swamp and the swamp in the Wallkill valley in New York state, the Clyde swamp in Michigan or the Sciota marshes in Ohio.

Good illustrations of muck formation in abandoned channels and backwater areas in river or creek bottoms are found in the Canaseraga or Conewango creek beds in New York state.

The remains of vegetation have fallen into these places. The air being excluded from the dead plants by the saturated condition and the temperature being held low, little

decay is possible. Therefore, the annual accumulation of dead remains exceeds the annual loss caused by decay, resulting inevitably in an ever increasing amount of vegetable remains.



Rear of a Dipper Ditching Dredge at work on the Western New York Farms Co. muck at Elba, N. Y.

With the vegetation is generally found some mixture of upland soil or "wash." If this were not so, the muck would be simply a mass of plant tissue. Muck areas differ with reference to a number of factors. Some swamps have been formed by sphagnum moss, notably the bogs of Ireland.

Good versus Poor Muck.—Some moss is found in most swamps in America, but a larger part of these areas are derivations

from higher types of plants; black ash, elm, swamp maple, and other deciduous trees and shrubs are often found growing on the most desirable muck areas and must have previously had ancestry. These generally signify to most experienced men that their characteristic growth is an indication that the soil will be suited to intensive forms of vegetable production. Often evergreens, cedars and tamarack predominate, and as a rule, muck made up largely of materials from such species is a less desirable soil for cropping, often spoken of as muck of low crop value. Oftentimes these latter trees grow on a soil that will not produce (after being cleared) a crop of either onions, celery or lettuce.

Stage of Decay of Muck.—The stage of decay and the physical condition of the soil are very important. Often the range is from raw peat—fibrous and with scarcely any decay—to the best quality of muck—fine, dark, advanced decay. Often these terms are confused. As a rule, the term peat should be applied to the fibrous material in the early stages of decay—coarse, woody soil with a low crop value. It contains very little of the

humus substances or other fine material. In comparison, muck represents an advanced stage of decay, having very little evidence of plant tissues and carrying a large proportion of humus. When it is perfectly developed, it is found to be finely pulverized, not coarse, with a black or brownish color. Its crop value is relatively high.

Practically, it is possible to find all stages of gradation between peat and muck, the variation existing both between different areas and even between different parts of the same area. In some cases, there is a large difference between the soil and the subsoil of a certain section, sometimes muck being better over a certain subsoil in one particular spot and poor at a short distance over another subsoil.

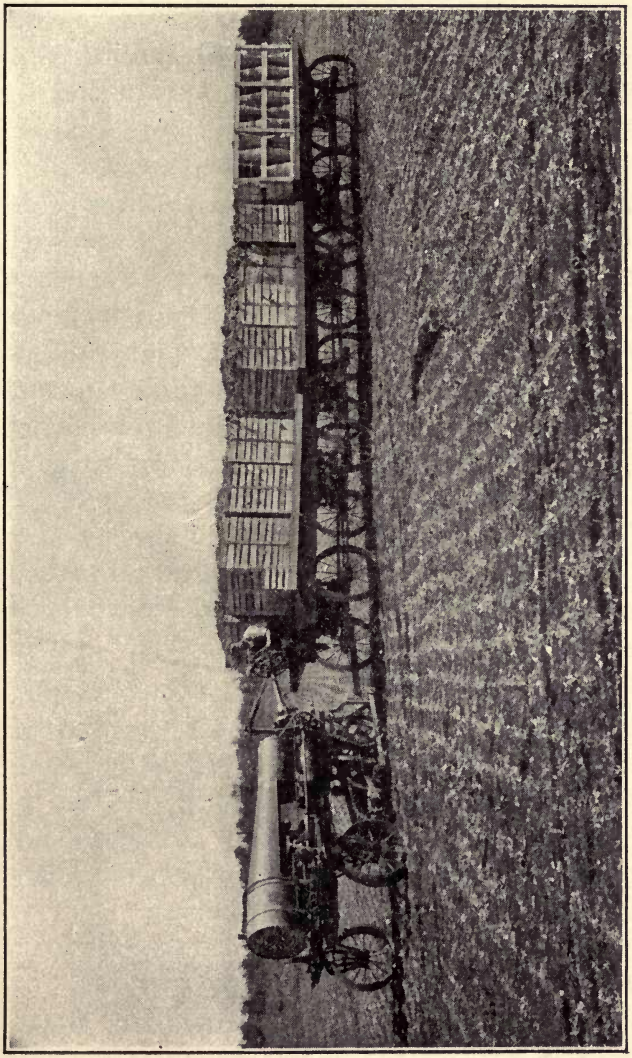
Certain areas, particularly if drained, may show a marked difference in their crop value, due no doubt to a difference in their stages of decay. The very peaty areas may become barren, then they are known as dry muck. This characteristic indicates important relations to water supply. A low water table will have an influence of continuing this barrenness, while a relatively high water table may obviate this difficulty.

Shallow versus Deep Muck.—Some muck areas are but shallow sheets, while others are many feet deep. Usually the larger the area, the more shallow the muck material and, therefore, the less desirable for certain crops. Small ponds or pockets between hills may be 20 to 50 feet deep, even up to 100 feet in some cases. Frequently the smaller areas are bathed by springs maintaining a very constant water table. Springs are found in the large bodies of muck, but owing to the large area, the springs tend to have relatively little influence in maintaining the water table. The question of maintenance of water table is very important, as it has much to do with the crop value of any area of muck.

Substratum.—The substratum immediately below muck is likely to be one of three materials:

1. Sand, generally a fine, hard packed type.
2. Marl, shell, or a fine granulated form.
3. Clay, blue or hard type which makes an impervious bottom and holds water.

As a general rule, some such impervious bottom is present. If the muck is deeper than 4 feet, the type of subsoil makes but



A Bates Steel Mule hauling 6 tons spinach off the muck of the Western N. Y. Farms Co.

little difference. Near the surface of the muck, clay is very objectionable, as it makes poor capillary contact with muck, thereby impeding the circulation of water. There seems to be but little choice between sand or marl at 3 feet, nevertheless marl is probably a little better in regard to drainage and moisture supply.

Marl is commonly found beneath muck beds, notably in New York there are several areas where the marl beds are many feet in thickness and approach within a few inches of the surface. A source of agricultural lime and cement is found in the marl of the Caledonia Swamp in New York. This marl is composed of a very pure, soft lime carbonate. It was probably formed in this place when the area was a deep, clear lake.

Water Holding Capacity.—As previously mentioned, muck is usually black or brown and more or less fibrous. When dry, it is very light, weighing per cubic foot from 15 to 40 pounds. As the stage of decay advances, the mineral content increases. Muck will hold a large amount of water from 75 to 87 pounds being found in 100 pounds fresh muck taken from beds. This is more than any other soil material.

While the total quantity of water retained is large, the proportion available for the use of crops per cubic foot is relatively little greater than for loamy soils, because so much water is held in such an intimate manner that crops cannot get it. Added to this, the capillary power of muck is weak, the more peaty the material, the weaker this property. An average muck will not raise water capillarily more than 15 inches to 2 feet. Sometimes 3 feet is about the limit for extra good muck. This fact must, then, have a strong relation to drainage and irrigation, suggesting the need of careful attention to both.

When drains are to be installed, the water table should be kept as near the surface as possible. If the water table cannot be maintained within 3 or 4 feet of the surface and the season is a dry one, such as 1913, in most sections it will be necessary to irrigate in order to obtain maximum yields.

Owing to the fact that muck holds so much water, it contracts and checks badly when dried. The importance of level culture and careful mulching is, thus, indicated. The dark color of muck tends to render it warmer than other soils, as it absorbs more heat from the sun. Nevertheless, this fact is counter-

balanced by the large water content of this soil, which renders it medium in season, or late if poorly drained.

Because of the organic property of muck, its crop properties are greatly improved with decay. Decay is, therefore, to be encouraged. All agencies for the increased capacity of properly handling muck and, therefore, advancing decay should be assisted.

Chemical Contents.—Muck, chemically, is an abnormal soil. It consists chiefly of organic material. The more material in the humus form, the better for the crop results. It is usually very rich in nitrogen, very low in potash, medium to low in phosphoric acid, and variable in lime content. When marl is found in the substratum, muck is usually well supplied with lime.

Some idea of the composition of muck soil may be obtained from the following table:

Name of place	Moisture	Organic matter	Nitrogen	Phosphoric acid	Potash	Lime
New York—						
N. Tonawanda ..		77.5	1.97	0.15	0.25	2.23
Oak Orchard		66.5	1.79	0.28	0.36	4.39
Red Creek		85.5	2.6	0.26	0.18	4.21
Maine—						
S. Sebec		86.9	2.77	0.17	0.02	
Brunswick		96.2	1.98	0.27	0.17	
Thomaston		57.2	2.06	0.46		
Burkettville		93.3	2.16	0.54	0.08	

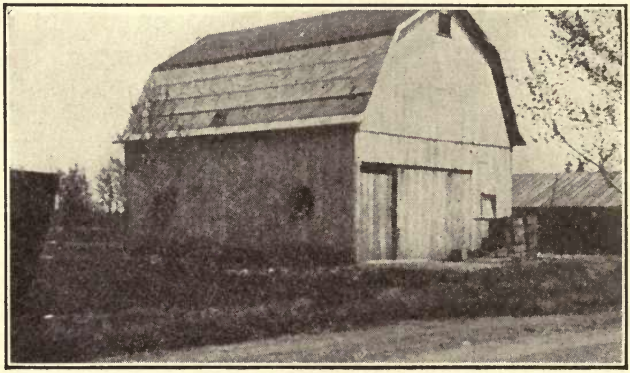
New Jersey—						
Beavertown	16.8	69.8		0.19	0.02	3.6
Michigan—						
Kalamazoo celery lands	6.5	63.7	2.53	0.88	0.34	6.9
Grand Haven celery lands	10.8	61.7	2.32	0.69	0.20	5.6
Ontario, Can.						
A	12.0	72.1	2.64	0.15	0.13	6.3
B	14.2	74.2	1.83	0.32	0.11	2.7
C	16.2	68.5	1.85	0.28	0.21	5.8
Average upland soil	0.5-0.5	0.5-0.4	0.1-0.4	0.5-0.4	0.8-2.5	0.2-0.4

The high per cent. of nitrogen is not a direct guide to the fertilizer treatment, as the soil will give up this nitrogen very slowly and through a long term of years.

The pounds of mineral matter in 100 pounds of water-free muck are shown in the following table:

	Sample A	B	C	D
Sand, silica, etc.	0.37	2.20	35.53	23.74
Iron, oxide and alumina	0.35	0.30	3.53	2.54
Lime	6.55	0.25	1.88	3.67
Magnesia	0.31	0.15	0.15	0.12
Potash	0.02	0.17	0.04	0.27
Soda	0.30	0.17	0.14	0.03
Sulphuric acid	0.70	0.10	0.34	0.82
Phosphoric acid	0.17	0.27	0.26	1.97
Carbonic acid, coal, etc.	4.29	0.20	0.20	1.45
Total ash	13.06	3.81	42.07	34.61

In samples marked A and B, the mineral matter probably consists for the most part of true ash—i. e., matter that once formed a part of the growing moss or other plants, although the large amount of lime in A may have come from shells of minute organisms often found in shallow water. The large excess of mineral matter in C and D must have proceeded from sand washed in from higher ground and is naturally poor in plant food.



A good storehouse, onion crib and shop on muck at Canastota, N. Y.

From the above tables, it is evident that whatever value mucks have as fertilizer is not due to the minute amounts of phosphoric acid and potash which they carry but to the

organic matter and its accompanying nitrogen. Mucks vary greatly in the organic matter which they contain. Occasionally a peaty muck will have as high as 95 pounds of organic matter for each 100 pounds of dry matter, while others will have little more than half that amount.

The nitrogen in mucks is for the most part in inert compounds and is not immediately available for plant food. The quantity of nitrogen in mucks also varies greatly. It is not a matter of indifference whether the muck is high or low in nitrogen content. While by far the larger part of the nitrogen in these materials is in a form that is insoluble in water and is considered, as a plant food, comparatively inert, it is a matter of common experience that this nitrogen may be made to contribute to the support of crops and that it has, therefore, a considerable money value.

Muck-like Substances.—There are certain substances that resemble muck in appearance. An analysis of some of these will show their differences.

The following table shows the constituents in 100 pounds of dry matter.

	Organic matter	Nitrogen	Phosphoric acid	Potash
Sea shore "muck"	77.3	0.69	0.16	0.62
Decomposed sphagnum..	——	0.87	——	0.12
Mussel mud	——	0.32	0.16	1.06
True peat	81.9	0.34	——	——
Drift on lake shore.....	——	2.07	0.25	0.19
Soil from dyked marsh..	——	2.45	0.24	0.28

CHAPTER II

WHERE IS MUCK FOUND?

Muck soil is found in every section of the world, but most abundantly in the cool, temperate region of which the northern tier of states in the United States, Canada, and the northern half of Europe and Asia are representative. It seldom occurs in as large bodies as other soil types do, and is inclined in many cases to occur in small, isolated patches.

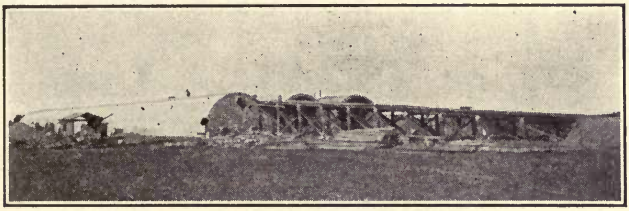
Europe is said to contain 212,700 square miles of swamp. These bogs are common in Norway, Sweden and Ireland, on the North German plain and in large parts of Scotland and Holland. Russia also has extensive deposits, there being about 70,000 square miles in European and Asiatic Russia. Asia has a great abundance of muck and peat in China, Korea, Japan, and other parts. In the southern part of Africa, in South America, in Brazil, in Terra del Fuego, the Falkland Island and elsewhere, it is also found.

It is estimated that Canada has over 30,000,000 acres of bog land, a large portion of which could be drained and used for agricultural purposes. There are about 20,000,000 acres in the United States, the amount workable being practically unknown. The peat and muck formation reaches its greatest development in Florida, on the Mississippi flood plain, in North Carolina, Virginia and New York. Surveys have been made in New York, Michigan, Iowa, Indiana, Massachusetts, New Jersey, Connecticut, Maine and Wisconsin, resulting in the finding of large quantities of swamp lands.

There are 65,558 acres of muck and peat in Florida and Louisiana, about 24,640 acres in Kentucky, Louisiana, and Nebraska, and in New York and Ohio there are at least 532,842 acres. All of these soils when drained are highly valuable for vegetable raising.

It is clearly apparent that in the peat and muck deposits of the United States there lies a vast amount of raw material which, for the greater part, has been left practically undeveloped. Much of this material might be

utilized economically and would serve to supplement the resources of the nation.



Storage on the Western New York Farms Co. property at Elba, N. Y., capacity per tunnel 24,000 cu. ft. The tubes are filled from the top through manholes which also serve as ventilating openings. The tubes are emptied from the bottom on the level with the outside ground

Typical Swamps.—A few illustrations of typical swamps in New York serve to illustrate what may be available elsewhere. Cicero Swamp, which contains one of the best large muck areas, is about 1½ miles south of Oneida Lake. Its extreme length is about 25 miles, while its broadest part is about 2 miles wide. Three streams pass through different parts of the swamp, flowing into Oneida Lake. The eastern portion, known as Corvaselon Swamp, has been drained by the Douglas ditch. The drained land has been cleared and cultivated.

In the uncleaned parts, the original vege-

tation continues to flourish, being composed of soft maple, red elm, and shrubbery. May mosses and ferns are abundant, but sphagnum moss is lacking.

The top stratum is composed of a spongy muck, very light in weight, therefore easily blown away. Windbreaks of cedars and poplars have been planted to check the damage wrought by the winds. A large part of this muck is partially decomposed wood, easily cut with any sharp instrument, as a spade or shovel. In the cultivated portion, the surface is black, well adapted to all kinds of vegetables.

In the western part of the swamp, in the town of Cicero, the surface conditions are entirely different from those of the drained portion north of Canastota. Here are found arbor vitae, scrub pine, tamarack, and other shrubbery typical of a cedar swamp. The muck is deep, 6 to 8 feet, underlain by marl, but from its tree growth it might not give as good satisfaction as the muck north of Canastota.

At South Lima, N. Y., is a body of muck about 575 acres in extent. Very little of the original growth is left, most of the land being

under cultivation. A good sized main ditch drains this muck, with many laterals and sublaterals reaching out in all directions to drain the land correctly. The soil is a brownish black to black muck, very productive, being especially so regarding celery, lettuce, spinach, and onions. Some of the choicest lettuce in the state is grown here. The area is divided into plots, 40 to 50 acres being a large holding and 5 to 10 acres being about an average.

There are many other bodies of muck, some of the smallest being only ½ or ¼ acre in extent. Many farms have these small bodies of muck. The owners should look them over carefully to determine their possible drainage and utilization.

ACREAGE OF UNRECLAIMED AND RECLAIMED SWAMP IN THE NORTH CENTRAL STATES

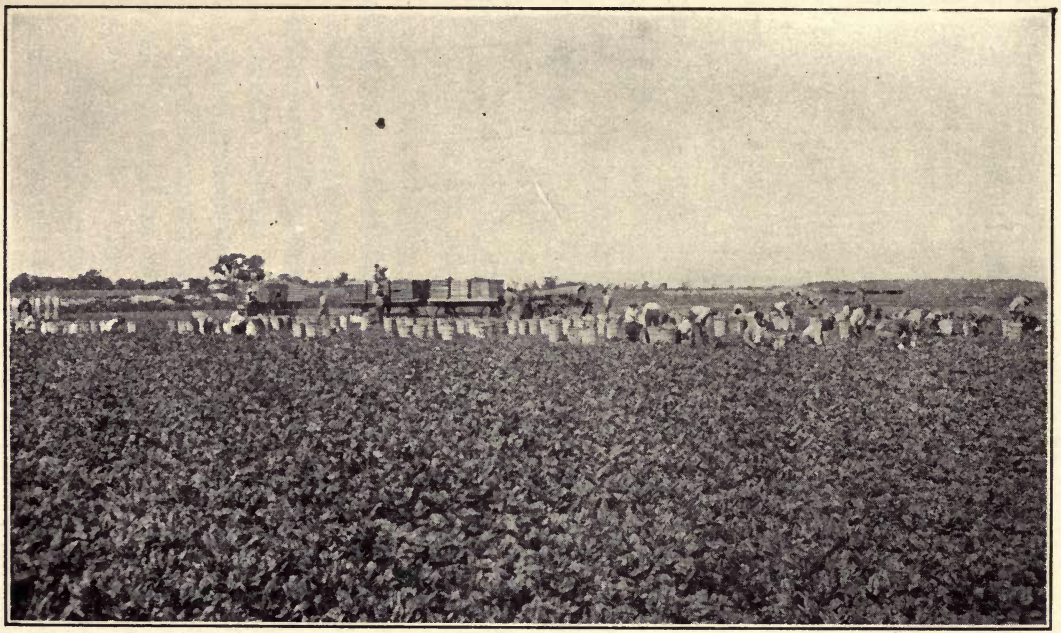
State	Unreclaimed Swamp Acres	Reclaimed Swamp Acres	Total Acres
Illinois	925,000	3,496,000	4,421,000
Indiana	625,000	3,358,000	3,983,000
Ohio	155,000	3,400,000	3,555,000
Michigan	2,947,000	1,600,000	3,547,000
Minnesota	5,832,308	1,500,000	7,332,000
Iowa	930,000	915,000	1,845,000
Wisconsin	2,400,000	400,000	2,800,000

CHAPTER III

OF WHAT VALUE IS IT?

Muck is valuable in many ways. It may be used as fuel after being dried; as humus for a soil maker or renovator; as a fertilizer either alone or in combination with other materials; or as a soil in which to grow plants. The consensus of expert opinion is unanimous as to the great value of muck as a soil maker, a soil renovator, and a fertilizer. It is a serious question whether the great value of muck as a fertilizer or crop producer should not exclude its use for other purposes. Corn has been used as a fuel, corn makes a good fuel, but it makes a better food.

Muck makes a good combustible, but it is a question whether its greatest value as an improver of the soil and as a fertilizer does not call for its wise conservation and use in the intensive and more careful agriculture that is rapidly approaching. The farmer is learning to save and to utilize more carefully his barnyard manure. He is also learning to



Cutting spinach by hand at Elba, N. Y., for canning factory, Western N. Y. Farms Co., 1915. Yield about 8 tons per acre.

appreciate the benefits of a wise and intelligent use of commercial fertilizers when applied to muck, in order to produce maximum crops of choice vegetables.

Value as Fuel and Other Purposes.—Muck is so closely related to peat that it is practically impossible to individualize it. A good definition of each would be: peat, decaying vegetable matter formed in swamps, generally coarse material. Muck—peat which is in a finer state of division, or peat which has disintegrated, owing to action of weathering and to soil organisms, and turned black in color. Generally, muck contains more ash than peat. No sharp lines of distinction can be drawn between peat and muck.

It will be necessary to give figures representing both muck and peat as to value as a fuel.

It is estimated in northern Europe alone approximately 10,000,000 tons of these materials are prepared and consumed annually as fuel, stable litter, for sanitary purposes, and in various arts and trades. A division of this amount would show Russia producing 4,000,000 tons annually, Germany 2,000,000, Holland and Sweden each

1,000,000, the remainder, 2,000,000 tons annually, being produced in the other northern portions of Europe, principally England, Ireland, Denmark, and Holland.

A marked development in the utilization of peat for the manufacture of fuel, illuminating and producer gas, for the production of ammonium salts and other byproducts, has recently taken place in Sweden, Germany, Russia, and other countries of Europe, and has aroused new interest in the possibilities of the full latent value of peat deposits as public resources.

Davis* estimates that the total area of swamp land in the United States is nearly 140,000 square miles. Of this, 8 per cent. or about 11,200 square miles, is assumed to have peat beds of good quality—this is peat probably under the best muck in the United States—averaging at least 9 feet in depth and containing 200 tons of dry fuel per acre for each foot in thickness. This equals 12,888,500,000 tons of dry fuel. Its value at $3 a ton, if compressed into bricks, would be $38,665,700,000.

---

* Bulletin 394, U. S. Geological Survey

The value of coke and byproducts he has summarized as follows:

ESTIMATED QUANTITY AND VALUE FOR UNITED STATES, 1908

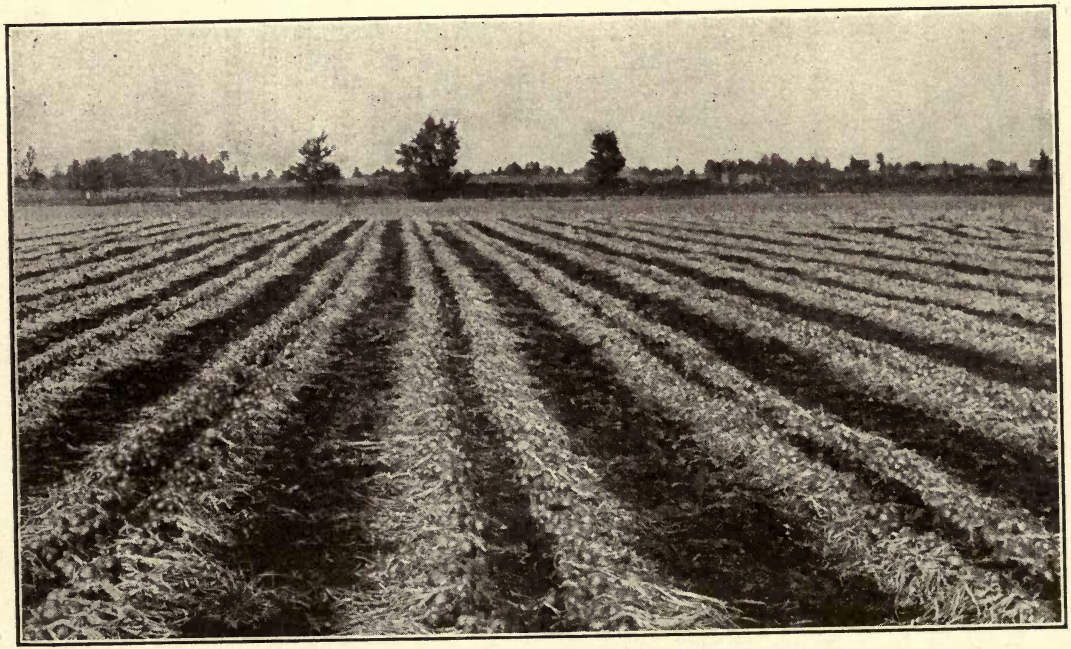
	Products in tons	Value
Peat Coke	3,608,800,000	$26,005,300,000
Illuminating oils	257,800,000	4,474,200,000
Lubricating oils	90,200,000	
Paraffine wax	38,700,000	3,479,900,000
Phenol	167,500,000	66,345,100,000
Asphalt	25,800,000	824,900,000
Wood alcohol	43,800,000	7,844,000,000
Acetic acid	56,700,000	2,268,800,000
Ammonium sulphate	39,900,000	2,777,400,000
Combustible gases	738,400,000	6,501,300,000

The sum total of which is so great that it fairly staggers the average individual not conversant with muck and peat possibilities.

Muck as Fertilizer.—It is not best to take large quantities of muck from the swamp and immediately spread it on the land. The muck should go through a process first. The muck may be acid. This should be changed. The nitrogen is comparatively inert and should have an opportunity to become somewhat available before being placed on the soil. Soil life, such as bacteria and insects, are also lacking in fresh muck.

In the preparation of muck for manure, as well as in consideration of preserving farm manures, the question of composting naturally presents itself. When muck is exposed to the action of the air, as in a compost pile or when mixed with ordinary cultivated soil, its nitrogen slowly undergoes change and is gradually rendered available to the growing plant. Through the action of bacteria proper to soils, the nitrogen constituents in the muck are changed to ammonia. The most favorable conditions for this bacterial action are moisture, air, warmth and the absence of acidity. The correction of acidity may take place by the addition of lime or wood ashes.

While the ability to procure commercial fertilizers readily has caused composts to fall somewhat into disrepute—and while in certain localities near cities, it may be more profitable to expend labor in hauling stable manure than in building muck compost heaps—it is true of a state of small farmers, for whose labor there is at times no profitable outgo, that the making of composts of muck, with stable manure or cultivated soil, is surely destined to become one of the most important items in farm management.



Yellow Danvers Onions, season of 1913, Syracuse Gardens Co., Syracuse, N. Y.
Crop yield 900 bushels per acre.

Some mucks ferment of themselves when thrown into heaps, and such kinds serve well as manures without weathering, fermentation, or any kind of preparation. But the kinds most common are well nigh useless as manures unless they have been rotted or fermented. In view of these deficiencies, it is not strange that farmers frequently deem mere exposure of muck to the air to be a sufficient preparation of this material. While this is the case with some mucks, the safest and surest way of obtaining good results is to ferment artificially in the compost heap.

Experience teaches that in many situations a large proportion of the useful ingredients of dung and urine can be saved by composting with muck. It is equally certain through such composting the unavailable plant food of the muck is made available. The ferments are present in such amounts in farm manures that, left to themselves, they suffer by the fermentation; and most mucks are so deficient in ferments that, by themselves, the fermentation necessary to render their inert organic matter available will not take place. Addition of the two would, therefore, be valuable to both.

The use of muck as a stable absorbent adds greatly to its store of nitrogen, because of the nitrogen in the urine thus taken up, and the germs always present in manure accelerate the conversion of the inert nitrogen into available forms.

In the preparation of muck composts, dung or fish is the material commonly used to excite fermentation. Sometimes garden loam is used. Most farmers prefer to make composts in heaps. A common plan is to lay down a bed of muck 6 or 8 feet wide and of indefinite length. The muck should be a foot or so thick, being covered with a layer of dung of somewhat less thickness, 6 to 8 inches, followed by another layer of muck and so on. Different farmers use very different proportions of muck.

The ordinary practice seems to vary from 1 to 5 parts of muck to 1 part of dung. Rich dung from stall-fed stock will ferment more muck than that from animals less highly fed. The practical rule is to use no more muck than can be thoroughly fermented by the manure. In case of sour or acid muck, the addition of small amounts of lime or wood ashes will correct the acidity and hasten fermentation. It will be noticed that the farm

supply of manure can be more than doubled by utilizing muck.

Nitrogenous manures cost more than others, for the simple reason that concentrated nitrogenous compounds capable of supplying this element to plants are neither abundant nor readily prepared. It is, therefore, of great importance to recognize clearly the value of muck in this regard and also for its humus.

Muck as Soil Restorer.—There are at least four benefits resulting from the mixing of muck rich in humus with soils deficient in vegetable matter.

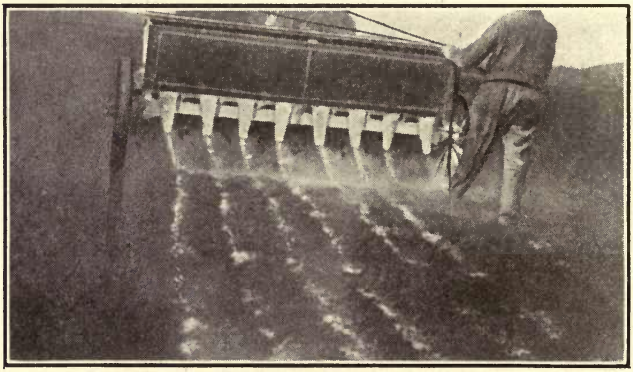
The first beneficial result is the lightening of the soil. A comparison of the weights of a cubic foot of different kinds of soil will bring out this fact.

1	cubic	foot	of peat	weighs	30 to	75	pounds
1	"	"	heavy clay	"		75	"
1	"	"	vegetable mold .	"		78	"
1	"	"	com. arable soil..	"	80 to	90	"
1	"	"	sand and clay....	"		96	"
1	"	"	sand weighs	"		110	"

As a general law, it has been found that the specific gravity of soil decreases inversely as its content of humus.

By using these figures, if one adds to a

heavy soil composed of sand weighing 110 pounds a cubic foot an equal amount of muck weighing 40 pounds a cubic foot, the result would be a soil weighing 75 pounds a cubic foot. If a soil of mixed sand and clay weighing 96 pounds a cubic foot is mixed with muck weighing 40 pounds a cubic foot, the resulting soil would weigh 68 pounds a cubic foot.



Spreading lime on muck, March, 1915. E. R. Hay, North Rose, N. Y.

The increasing of the absorption of solar heat by such a soil would be the second beneficial result. An important factor in the growth of vegetation is the quantity of heat absorbed from the sun by the earth. Physic-

ists have determined that a black surface will absorb a much larger amount of heat than a surface of any other color, providing other things are equal. It may be, therefore, stated that muck which is natural black or brownish black will absorb more heat than soils of lighter color.

It may be further inferred that muck added to lighter colored soils will cause these soils to turn darker and, therefore, absorb more heat. As a result of this dark color in the soils, vegetation will be produced before the early frosts, maturing more rapidly during the growing season, thus escaping in a measure the loss caused by early fall frosts.

The third and fourth beneficial results concern moisture in the soil: the slower evaporation of moisture from these soils and the soils' increased capacity for absorbing and retaining moisture.

Analysis of soils will bring out the fact that muck soils will hold more water than some other types.

75 to 87 lbs. in 100 lbs. of fresh muck
49 lbs. in 100 lbs. cultivated muck
0.23 lbs. in 100 lbs. light sandy
1.30 lbs. in 100 lbs. of heavy fine sandy loam (truck soil)
1.28 lbs. in 100 lbs. of clay loam (good corn & wheat soil)
3.56 lbs. in 100 lbs. of sandy loam (Texas)
3.26 lbs. in 100 lbs. of silt loam (Texas)

A sample of soil from Nebraska used for beet production was compared with two samples of muck from Florida in regard to its absorptive power.

	Nebraska	Florida A	Florida B	Florida C (a very sandy soil)
Trial No. 1	45.75%	144.85%	109.13%	46.86%
Trial No. 2	44.85%	145.43%	107.93%	46.51%

Deductions from these figures are: as the percentage of muck increases in a soil, the capacity of that soil to absorb and retain water increases.

It might be stated: as a soil is improved by additions of humus (such as muck or manure) its absorptive and retentive powers increase.

It is necessary to make very large applications of muck to a soil when it is used to improve the structure of that particular soil. A practical application would be from 20 to 40 tons. It should be aired or composted before applying as mentioned previously, for the best results.

Several brands of muck or peat are offered for sale on the general market. H. B. Fullerton, agricultural director of the Long Island railroad, says: "For a number of years

we have been seeking something to supply the exhausted leaf mold or vegetable matter which is the prime requisite for vigorous plant growth. Strawy manure, long used to accomplish this end, is at the present day difficult to secure, hard to handle, and offensive, hence we have tried everything we could find with varying success until we struck the black vegetable mold or humus. This we have tested most thoroughly at both stations with universal success, having raised celery, onions, lettuce, and many other crops with no other aid on the light sandy loam in the central section of Long Island. We have also been able by its use to keep our lawns in superb condition throughout the usual dry season of summer. Hence we have no hesitancy in saying that the utilization of this vegetable matter is a rational method of treating soils."

Experiments tried out in Wisconsin, where a low grade muck combined with 4 pounds of muriate of potash and 8 pounds of acid phosphate to the ton was used compared with ordinary manure, gave results during four years with a larger yield of corn where the muck was used than where the manure was used.

The value of a ton of muck for the plant food varies from $3 to $4.50 a ton dried, but considering the benefit derived from the humus, it may be worth $8 or $10 a ton dried.

Horticulturists in England have been interested for some time in an attempt of Professor Bottomley to prepare a new fertilizer from peat. Frederick Keeble in Nature has quite comprehensively outlined the extent of his work.

Mr. Keeble claims, "the reasons for that interest are manifest: farm-yard manure is constantly increasing in price and decreasing in amount, and artificial fertilizers cannot impart to the soil those physical properties without which plants do not thrive.

"The market gardener accustomed to raising large crops on land treated with numerous applications of manure—100 tons or more to the acre—is only too anxious to discover other and less costly means of enriching the soil, and even the general public is alive to the importance of increasing the fertility of the land.

"Briefly, the story is, that certain aerobic bacteria possess the power of liberating from peat large quantities of soluble humates. These soluble humates are in themselves of

service to plants as sources of food. They serve, moreover, as a culture-medium in which nitrogen-fixing bacteria (azobacter chrococcum, etc.) multiply rapidly. Hence by adding cultures of nitrogen-fixers to sterilized humated peat, the amount of nitrogen in the latter is increased.

"It was to this large nitrogen content that Professor Bottomley originally attributed the fertilizing powers of bacterised peat. Tests carried out at Kew on many different kinds of greenhouse plants—lillies, cyclamen, coleus, primulas, etc.—indicate in the most striking manner that the addition of bacterised peat to a potting compost brings about a great increase of growth and vigor. The amount of bacterised peat (or humogen, as it is sometimes and somewhat inconsequently called) which produces these results is about 10% of the total compost.

"Those who take the trouble to reckon what 10% means in tons per acre will recognize that, unless far smaller dressings of bacterised peat may be used, this fertilizer cannot be applied with success to field crops. Indeed, in certain field experiments which we have witnessed the addition of dressings of

bacterised peat at the rate of two tons to the acre produced no beneficial results.

"Potted plants treated with bacterised peat show, as compared with controls, not only increased growth but sturdier habit and greater root-development. This fact led to the suggestion that the phenomena cannot be attributed solely to the nitrogen-content of the fertilizer. It is, for example, a well-known fact that the addition of phosphorus-containing fertilizers bring about the development of a more vigorous root-system than is produced in soil poor in available phosphates.

"Following up the suggestion that the virtues of bacterised peat are to be sought elsewhere than in the nitrogen contained in the fertilizer, Professor Bottomley was led to the very interesting conclusion that the growth of plants is conditioned not only by the well-known substance-producing food materials, but also by hitherto unknown growth stimulators. These substances, which he claims to have isolated from peat, Professor Bottomly has called auximones. He believes that they play a part in plant-nutrition somewhat similar to that played by accessory food bodies in the nutrition of animals."

Value as Cropping Soil.—Raw muck without any improvements is worth about $5 to $10 an acre; with some improvement it is worth $50 to $75; and with more improvement, in fact fitted for cropping, it should bring from $75 to $350 an acre. Muck at Canastota, N. Y., two miles from railroad shipping station, improved and under crops, brings $300 to $350 an acre, and very little for sale. Back a mile or two the price is somewhat less, dropping lower as distance from shipping point increases until low price, raw muck is reached.

The A. M. Todd Company's 2,100 acres in Michigan, worth $1 or less an acre 25 years ago, are worth $200 to $300 an acre at present and probably could not be purchased for that figure. Some tracts of muck partly developed located in Orange county, N. Y., sold within the year 1913 for an average of $65 and $75 an acre.

A short sketch published in the Market Growers Journal about the Arkport, N. Y., celery beds gives some idea of the crop value of muck.

"Twenty years ago residents of a secluded valley in the 'Hill District' of southwestern New York asked the Legislature to drain a

The newest muck of the Western New York Farms Co. First crop celery, much of which yielded 170 crates per acre

stagnant swamp of black, oozy muck which was a menace to the public health. Today this swamp, rated on the value of its output, is the greatest celery field in the United States, being surpassed only by the fields at Kalamazoo, Mich., and is said to surpass that well-known section in the quantity produced.

"These celery lands extend a distance of several miles along the valley between the villages of Burns and Arkport and range from a few rods to a mile or more in width. It is estimated that this year's crop alone will bring into this community over a half million dollars, and this from land once declared a 'public nuisance.'

"A striking feature of the business of the Arkport-Burns region is that nearly half the celery is shipped 'in the rough,' that is, unwashed. Early celery brings, on the average, about 30 cents a dozen bunches and the late celery about 25 cents a dozen at the station. The early crop often yields as high as 8,000 bunches an acre, and the late crop 3,000 bunches. The greater part is shipped to Pittsburg, Philadelphia, and New York markets.

"The largest individual grower in this section is C. G. Locke of Arkport. He is said

to receive on an average of $30,000 a year for his crop."

In later chapters, each crop will be taken up in detail, giving the value returnable from the same.

Crops Raised on Muck.—Three principal crops are raised on muck: onions, celery, and lettuce. However, many others are becoming more common each year, and to this list must be added asparagus, beets, both table and mangels, cabbage, carrots, cauliflower, sweet corn, field corn, mint, peas, spinach, oats, hay and many other crops.

If one wishes to build air castles, take the figures of the total best muck in the United States as estimated by Davis. If these were all planted to onions, celery and lettuce, in equal proportions with an average yield and average price returnable, one would soon find the total crop figures would be stupendous and the value immense.

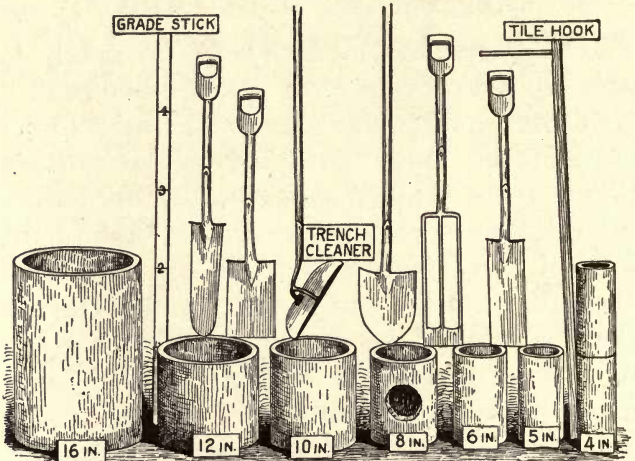
We do not, however, need these figures to demonstrate conclusively that the money value to be derived from growing crops on muck soils is certainly very large. This is especially true to those who understand thoroughly the growing and marketing of crops from this class of soils.

CHAPTER IV

RECLAIMING MUCK LAND

If a farmer has a small body of muck, ¼ acre to 10 acres, or even a large bed, and it is desired to clear this area and bring it under cultivation, there are several important points to be studied very thoroughly before undertaking such a proposition. One of the first of these factors is to go over the land carefully and lay out a plan for developing the project. A few readings with a carpenter's level and some borings with a large auger known as a soil auger, or even a post hole digger, may teach a farmer a great deal about his swampy land. A ditch, water of which he thought was 3 to 4 feet below a certain point on the marsh may be only 1 foot lower. In 1,000 feet on the marsh where he thought there was only 1 foot of fall, there may be 3 or 4 feet. In a like manner, an examination of the subsoil may show the muck is 6 feet deep where he thought it was only 2 or 3, and where he thought there was a tight blue clay subsoil, there are streaks of sand or marl.

Clearing.—If there is considerable growth of trees and shrubs, it will be necessary to first cut these away. The trees, brush, and everything that grows on this wild land,



Tools for Tile Working

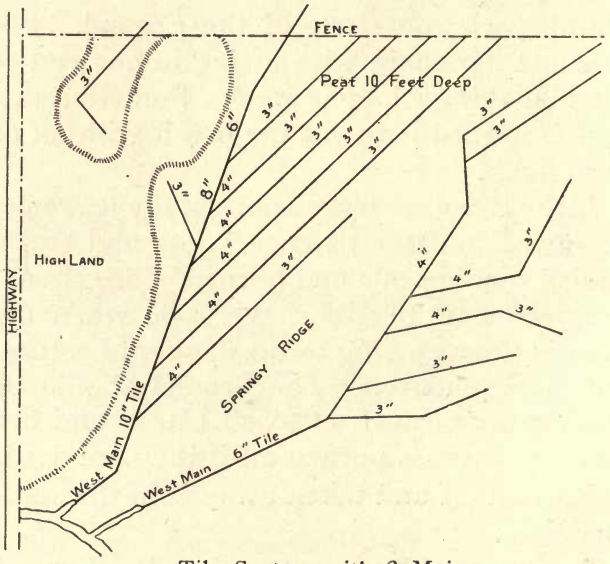
usually have their roots almost on top of the ground. This shallow rooting is caused by the high water table. The easiest way to rid the land of tree and stump is to take both at once. This may be done by cutting off all roots at least halfway around, starting several feet out from the trunk of the tree. Then with a pair of pulley blocks and a long rope

attached high in the tree and a team of horses or preferably a yoke of oxen on the other, the tree will generally start and the balance of the roots can be cut off as they are exposed. Dynamite placed correctly under the base of the tree will throw the tree down and the stump with roots out of the ground. For brush, a log chain with a ring in one end to use in making a loop is good. Sometimes all that is needed is to cut the brush with ax or bush hook.

If the trees are large enough, the logs may be sawed and the balance, roots and trash, hauled to a big pile and burned. Care should be given not to light this pile when the ground is dry, owing to the danger of setting the muck on fire. The ground should be thoroughly cleaned of small brush, and the weeds and grass burned off if they are dead, or mowed off and taken away if in the summer time.

Drainage.—The next point is that of drainage. Often it is necessary to look to the draining first, in order to start the work of clearing. The draining of the land would naturally be considered under at least three headings: First, outlet, whether an outlet is available or not; second, the source of the

water and third, what to install for drains and how. Frequently, deposits of muck are so situated in pockets or depressions in the ground that it is practically impossible to obtain a good gravity outlet for drainage,



Tile System with 2 Mains

either by open ditches or tile. Sometimes when muck is located near a lake or pond, the level of the lake, by reason of certain winds, is at times above the ground that is to be reclaimed. This is quite noticeable along the south shore of Lake Erie.

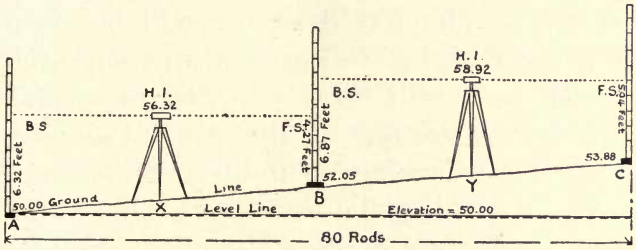
In the case of the small deposits of muck, it is sometimes best to consult an engineer before going to any expense in the way of drainage, especially if there is any doubt in one's mind as to having a sufficiently deep outlet. A farmer who has studied his muck and thought intelligently on the subject of drainage ought to be able to stake out a fair drainage system. A few moments of a surveyor's time would test the feasibility of the system. If it appears that changes are necessary and possible, they could be easily and wisely made at this time.

In the case of the larger bodies of muck, from 100 acres up, which are held by a number of owners, the aid of the state or county should be sought, as the law in the case may determine. Most of the states have laws covering drainage that are intended to fit these muck conditions. As a general proposition, the county on petition of a part of the parties interested will have surveys and estimates made. If the drainage will benefit a sufficient number, the county or state will issue bonds covering the cost, let the contract, and tax, the benefited land for the same, in most cases extending the time of payment over several years.

Farmer May Use Level.—Familiarity with the level and the methods of handling it and of recording the notes may enable a farmer to do his own surveying. A surveyor's level and tripod may be purchased for $10 or more. A $50 instrument would give satisfaction and may be the purchase of five neighbors cooperating. Accurate readings may be made with this instrument on a rod held 20 rods away.

How To Use Level.—Suppose that points A and C are 80 rods apart and it is desirable to know how much higher or lower C is than A. Set up the level firmly at X, 20 rods from A, and center the bubble. Have the rodman hold the rod on a firm stake driven flush with the ground at A. Read the rod where a level line from the instrument strikes it. This is a back-sight reading and is 6.32 feet (about 6 feet 4 inches). This means that the instrument is 6.32 higher than A. Assuming for convenience that A has an elevation of 50, the height of the instrument is then 50 plus 6.32 or 56.32. Now drive a stake at B, 20 rods from the instrument and point the level at a rod held on it. Be sure that the bubble is centered and read

the rod for a front-sight, which is 4.27 feet in the case above. This means that B is 4.27 feet lower than the height of the instrument. For this reason 56.32 minus 4.27, or 52.05, is the elevation of B.



Line of Levels

Then carry the instrument ahead to a point Y about 20 rods beyond B and set it up once more. With the bubble centered, read the rod held for a second time on B. By adding this back-sight reading of 6.87 to 52.05, which is the elevation of B, the new height of the instrument is found to be 58.92. Then by pointing the level at C and reading the rod there, a front-sight (5.04) is obtained, which subtracted from 58.92, gives C an elevation of 53.88. Since A has an elevation of 50, it is evident that C is 3.88 feet higher than A. A line of levels has been run from A to C.

Source of Water.—If the question of outlet has been settled, the next question is the source of the water to be drained. If the area is a small pocket of muck, either in a valley or with the land sloping gently toward it, the first drainage will be from toward the higher and usually an open ditch is best, as it will serve to catch the water that comes on top of the ground during heavy storms. This open ditch will prevent wash-outs, as it will divert the surplus water from the surface of the cultivated ground.

Quite often, if the area to be put under cultivation is only a few acres in extent and is but a few feet deep, the drain around the outside will be all that is necessary. If the muck is so situated and shallow, and as well underlaid with blue clay or an impervious hard pan, it will be best to wait and see the results of this outside drain before doing more. Shallow muck dries out very fast when the water supply is cut off, and in laying out drains in cases of this kind, provision should be made to hold back the water in dry times, or a supply of water in reserve should be turned into the ditch, otherwise in dry times an irrigation system will be necessary.

If the muck is deeper than 4 feet and the area larger, the chances are that it still needs additional drainage, either by open ditches or tile. Open ditches are the most common, because they are cheaper to install. However, they are unsightly, wasteful of land, and furnish a place for weeds to grow and usually develop plenty of seed, thereby increasing the labor of weeding. In the long run, particularly for laterals, the tile is cheaper in many cases. The cost of tile will often be covered by the crop that can be grown on the space taken up by the ditch and its banks, frequently in one season. An open ditch and its banks is, as well, a constant expense as nearly all muck heaves badly or blows away, filling the ditches, which it is usually necessary to clean each year.

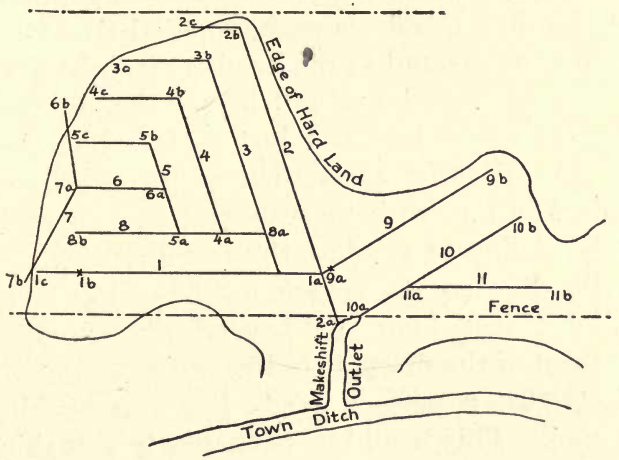
Cost of Main Ditches.—Big marshes containing sluggish, winding streams need outlet ditches, which are made by deepening and straightening the water courses. An outlet ditch should be deep enough for underdrainage and wide enough to carry the flood flow of surface water. A fall of 1 foot to the mile may be sufficient for a large

ditch. More fall is preferable. Almost all marshes have fall enough to make an outlet feasible if the ditch is continued far enough downstream. A few lines of tile or open ditches at the foot of the upland to cut off the seepage connected with the outlet ditch near the center of the marsh may prove satisfactory.

A ditch 6 feet at the bottom, 7 feet deep, and 20 feet wide at the top, costs about $1,600 a mile when there are 3 or more miles to dig. A single mile would cost $2,500 or more. Depending upon the width of the marsh, the average cost for each acre is from $5 to $10.

The water in an outlet ditch should be enough below the banks to afford an outlet for a line of tile or open ditches which may be laid to it from any part of the muck of which the main ditch is the direct outlet. If tile are used, the line should have a depth of 3 feet at the head or upper end and a gradient or slope of one-tenth foot in 100 feet. On a level marsh with no part more than a mile from an outlet ditch, this means that the 3 feet of depth at the head, added to the 2.64 feet of fall in the half mile, requires a

depth of a little more than 5½ feet at the outlet. If open ditch was used, about 7 feet at the outlet would be necessary. With an allowance of 1 to 1½ feet for the depth of water in the outlet ditch, it is evident that 6½ feet is minimum depth for tile outlet and 8 to 8½ feet for the outlet where open laterals are used. A ditch 3 feet wide at the bottom, 6 feet deep, and 15 feet wide at the top is the smallest that has a right to be called an outlet ditch under any conditions.



Tile System on Low Land (Muck)

Ditches shallower than this are for surface water primarily and a depth of 2 to 3 feet is sufficient.

Getting the Grade.—Suppose the farmer has found, either from the surveyor or by surveying himself, that the ground at the head of the line is a foot higher than that at the outlet. Then, if conditions are such that the outlet may be 3½ feet deep by making the head of the ditch only 3 feet deep, a fall of 1½ feet is obtained. If two stakes are driven in opposite sides of the proposed trench and a lath is nailed horizontally from one to the other, 1½ feet above the ground at the outlet and another is nailed two feet above the ground at the head, a straight line between these laths will be parallel to the desired grade line and just 5 feet above it. If several laths are nailed at intermediate points in line with the two end ones, a well defined line of grade laths is established.

By digging the trench until the top of a pole 5 feet long, held vertically on the bottom of the ditch, is in line with the top of the laths, a perfect grade line can be obtained. This would be particularly valuable with tile and would be beneficial with open ditching. However, most of the latter are dug without regard to grade other than that given by running water found in the

bottom of the ditch. In both cases, the digging of the ditch is commenced at the outlet.

The ditch for tile should be dug perfectly straight, and the bottom cut with the spade, made as narrow as possible, and finally finished with the tile scoop. The English tiling tools will be found useful for this work. Where an experienced man is available, he will not need a guide for grading, but will carry the grade with the water. It has been found necessary in most cases, where tile is used to place a board below the tile to keep the tile from sagging, also necessary to cover the joints of the tile with some material such as old bags, tar paper or hay, to prevent the fine muck from filling the tile.

Tile Drainage.—If tile can be laid with from 2½ to 3 feet of soil on top of them, it is usually not necessary to put them closer than 50 to 75 feet between lines. If a true grade is maintained, as mentioned above, a very slight fall will carry the water where the work is carefully done. Muck does not require as large tile, nor does it need them so close together as other soils, as the ground is of a spongy open nature, retaining water longer and giving it to the tile very gradually.

PRICES, WEIGHTS AND AVERAGE CAR OF TILE

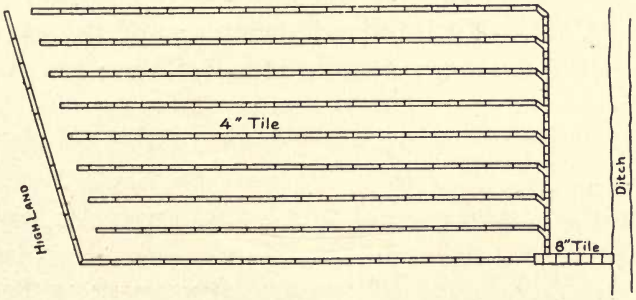
Diameter Inches	Price for 1000 feet	Pounds to a foot	Average carload Feet	Rods
4	$18	6	6500	390
5	26	8	5000	300
6	35	11	4000	240
7	45	14	3000	180
8	60	18	2400	144
10	80	25	1600	96
12	120	33	1000	60
14	185	43	800	48
15	200	50	600	36
16	225	53	500	30
18	310	70	400	24
20	400	83	330	20
22	500	100	320	10
24	550	112	300	18
27	800	150	240	15
30	1000	192	160	10

In laying tile, it is well to have as few outlets as possible; for as a rule the outlets being low down would become covered up, and if there were many, some might be overlooked. The best plan is to have one large main into which the laterals empty. This is also the best way for open ditches, unless the muck lies adjacent to the main outlet ditch.

Glazed tile seem to withstand the elements better, although they are more costly.

Examples of Tile Drainage and crops in two areas that were properly drained by tile will serve as examples. Both are located in Wisconsin and described by the Wisconsin station.

The area situated near Stoughton in Dane county, Wisconsin, is one of peat and muck to depths ranging from 3 to 10 feet. A peculiar ridge extending diagonally across the area from northeast to southwest has a gravelly subsoil at about 3 feet. This was



Tile System

the wettest and roughest part of the marsh, the bogs being over a foot high. The marsh had been pastured during dry seasons for years, but cattle often became mired.

The bottoms of the finished trenches in the muck and peat were so soft that two narrow strips of boards had to be placed on the bottom with a groove between them to hold the tile in place. Sometimes the tile had to be carried 20 rods by hand. This might have been avoided if the laying of the tile had been postponed until the open trenches had made the marsh firm enough to support the weight of horses.

There was a fall of 3 feet in the creek below the outlet of the 10 inch main. The creek was deepened so that 2 of the 3 feet were used to give the tile a better outlet.

Cost.—An itemized statement of the cost of the drainage system is as follows:

Surveying and preliminary work	$ 36
Tile and freight	286
Cull lumber strips	41
Labor (including hauling by teams one mile)	362
Total	$725

About 30 acres are made tillable by the system, making the average cost about $25 dollars an acre. The neighboring land adjoining this on the north paid a third of the cost of the main.

Insufficient borings. The borings taken along the line of the west main showed that the subsoil was uniformly clay. Upon digging the trench a bed of unlooked-for quicksand was encountered, which made the main cost at least $25 more than it would have cost in clay. Ten-inch planks were used as sheet piling on the sides of the trench to keep out the running sand while the tile were being laid.

Poor Management.—In an attempt to hurry the work, a larger crew was employed than could work advantageously in the number of trenches ready for construction, and the cost of the labor was thus materially increased. It is a mistake to begin digging a trench for a lateral before the main has been dug up to its outlet. Where only two men were employed, the cost of construction was less than 30 cents a rod for a 3 foot trench, while it was about 40 cents for the same work where 10 men were employed. Naturally with only two men employed, on a system as large as the one on the east side of the marsh, the work lasted long enough to make the men quite proficient at their work. Then also, the progress of construction was

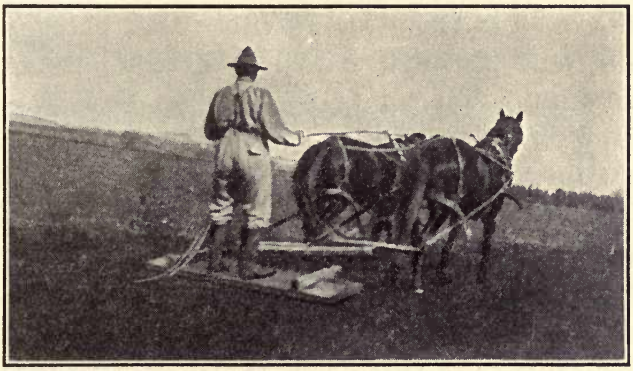
at a rate which made work easier on the last laterals because of the drainage afforded by the first.

Benefits.—One interesting result is that the seepage water in the gravel near the northeast corner is so intercepted and cut off that the ridge extending southwestward is no longer wet. This strip was left untiled as an experiment, and it is not probable that it will ever have to be tiled.

Another noteworthy result is that the raw peat in the north central part of the area has, by thorough drainage and the use of fertilizer, been made to produce its share of the 2,760 bushels of shelled corn that the 35 acres produced in 1911. Fourteen hundred bushels of this corn were sold for seed at $2.25 a bushel. The owner of this land is so well pleased with the results of his venture that he has bought 40 acres more of the same kind of land and is draining it.

Another area was called "good pasture land," but it was so wet that it had never been plowed. The tramping of cattle had made it rough. The muck was about a foot deep and lay on a blue clay containing streaks of sand. Areas like this are not as

good for pasture as they seem to be. Drainage not only makes better pasture of such land, but fits it for raising other crops as well.



Riding the Planker, Rear View. E. R. Hay's Farm, North Rose, N. Y.

Cost.—The tile were made in November, 1910. At 20 cents an hour for men and omitting the item of board for the men, and at 20 cents an hour for a team, the itemized statement of cost of the drainage system is as follows:

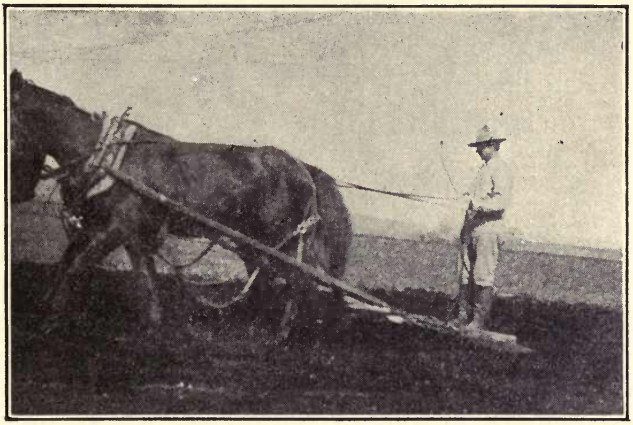
Labor	$140
Team work	50
Tile	125
Total	$315

A field of about 26 acres was thereby opened to cultivation. Only about 20 acres were actually tiled, so on this portion the cost of tiling averaged about $16 an acre. It would not be fair to include the cost of the open ditch in this, because that benefits the land through which it extends to an amount equal to its cost. The ditch was dug 1 foot wide at the bottom, 7 feet wide at the top, and 3 feet deep, for $1.50 a rod by a capstan ditcher. This is one of the few places in Wisconsin where an open ditch of these dimensions has been recommended.

Results.—As soon as the soil thawed in the spring of 1911, the rough surface was disced. This was done before work was commenced in any other field on the farm. About a week later, after the grain on the rest of the fields had been seeded, the new land was disced once more. This cut off the bogs so that it was ready for the plow. After some experimenting with a breaking plow and sod plow, a gang of two plows pulled by five horses was found to do the best work. Double discing and double harrowing prepared the land for the corn planter.

The corn was drilled and during the sea-

son was cultivated three times. Weeds scarcely grew at all, the cultivation being only to preserve a mulch. At no time was any portion of the area too wet to cultivate, except in two or three spots where short lines of tile will have to be laid to take care of the water from small springs.



Side view of the Planker. Notice the mound of soil pushed away by the planker oviating all hoof marks

The corn was cut on September 10, because of danger of frost. However, as there was no frost for two weeks after this, a better yield would have resulted if it had been left to mature. From 13 acres of the poorest portion, 110 tons of silage were ob-

tained. From the remaining 13 acres, the yield was 20 double boxes, or 500 bushels of shelled corn. This is not an exceptional crop, but fair, nevertheless, when it is remembered that no manure was added to the land. The crop of corn was enough to pay for the tile and leave a fair balance to pay for the cost of cultivation. The owner tiled the adjoining area of 20 acres during 1912.

Another area in New York.—Open ditches were changed to tile by Bonney & Ware of Batavia, N. Y. Mr. Bonney explains as follows:

"The proposition on our own farm, where we have reclaimed and utilized more than 50 acres of muck land, is the only one of which I can speak with authority. We have in the neighborhood of 100 acres which is strictly good muck and quite deep. We began operations about nine years ago by clearing and cultivating a few acres of this soil. Most of it was in timber, some of which was thick and heavy, and other parts covered only by brush.

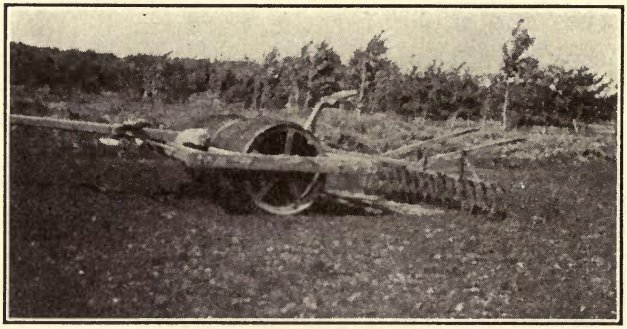
"Our drainage problem has from the first been a rather peculiar one. We have a large spring on the upper side of the muck area

which flows down past one side of our land, and the water ultimately flows into Tonawanda creek, more than a mile and a half away, and with a fall of less than 2 feet in that distance. Naturally, a large part of the water from this spring seeped out and maintained a wet condition of our muck land.

"Our method of draining the soil was to construct a large open ditch at one side and adjacent to the hill lands. Where this ditch leaves the muck for the hardpan bottom, the muck narrows between the hill. Across this neck of low land, we constructed a levee with a large ditch on the inside. After considerable disastrous experience with open drains, we finally constructed a pumping plant adjacent to this levee by means of which the water can be pumped over the levee and removed by gravity drainage, thus insuring the safety of our crops.

"A complete system of open ditches has been constructed covering the muck area and with the grades so arranged that the lowest point is at the pumping plant. Consequently, the drainage water accumulates at this lowest point where it may be removed by the pump. We use a large centrifugal

pump, operated by a gasoline engine. This same levee also serves as an insurance in another way, since it protects us from the backing up of the water from Tonawanda creek. It should be stated that, as far as possible, the ditches for the surface water have been constructed with a levee on the interior side. We thereby are protected from external flooding as well as insured of the removal of



A roller and mulcher or weeder used on the muck at Albion, N. Y. Both drawn at the same time

the rainfall and seepage which comes within our muck area.

"I may say that we have had no definite outline for our work—at least we did not have at the start. Our open ditches are from 10 to 16 rods apart, and from 28 to 100 or

even 160 rods in length, all leading into one central ditch which leads to our pump-house. These ditches are from 2 to 2½ feet in depth. We have tried some tile, and as far as our experience goes, it works well. We lay 6 inch boards in the bottom of the ditch, and after covering the tile with gravel and tar paper, put in the soil. As I have said, we find this system works very well. We expect to use old fertilizer sacks over the joints of the tile in future.

"Our pumping plant has not been operated a large part of the year. In the spring we are troubled with freshets, resulting from the melting snow and heavy rainfall. Then the water comes down in large quantities often converting the larger part of our muck area into a lake. We pump out this water until it is sufficiently low so that our tillage and seeding operations may be safely begun.

"We have found from experience that one of the most difficult propositions in the reclamation of muck land is that of the first plowing. The soil is normally loose and porous and filled with roots and stumps. If it also bears a sod, this adds to the difficulty, as the sod rolls up in front of an ordinary

plow rather than being cut by it. We have tried various methods to overcome this trouble, but finally devised a type of knife coulter which works quite to our satisfaction. We have a large plow and the share is kept very sharp, so that it will readily cut roots.

"Instead of adjusting this coulter with the point forward, as is customary, it is slanted backward. It is attached well forward on the beam of the plow and is long enough to extend diagonally backward at an angle of about 45 degrees and 3 or 4 inches below the bottom of the plowshare. It is also set several inches back of the point, so that roots tend to be drawn taut before they come in contact with the blade. This blade is kept very sharp, being ground frequently where necessary.

"By this means, we are insured from having our plow wedged into the land, and at the same time, the arrangement of share and coulter draws to the soil so that all ordinary sized roots are readily severed. The construction of this plow is very simple and is quite practical. An additional convenience is a hinged hook at the end of the

plow beam for quickly releasing the team should conditions demand it.

"In our experience the best crop to be first planted on muck soil is potatoes, and after one or more years, according to the character of the soil and when it is well broken down and settled, we may plant celery, onions, lettuce, and such other crops as we produce.

"We have been using open ditches and find them expensive and not satisfactory. We are putting tile in those ditches, main tile 12 inches and laterals 4 inches in diameter. The laterals are probably on the average 10 rods apart. I realize that this is a little too far, but we are getting fairly good results. We are putting these in, in the first place, for draining, and we use the same for irrigation. Our water supply is on the far side of the muck.

"The main line of tile is provided at the junctions with cement boxes and gates to shut off the water. When we wish to irrigate, we can close the gates and let the water into the distant ends of the laterals. When we have too much water, we pump it out. We have no natural drainage. We have

perhaps half the acreage under this system, and it has worked well for us so far."

Plowing.—As stated before, all of the vegetation on this kind of land is very shallow rooted, and as a general thing the roots are very tough—to protect the plant from heaving in the winter. If the ground has lain wild, the probability is that its upper layer to the depth of 12 inches is a mass of roots of alders, huckleberry, sumac, iron weed, fern brakes, cat-tails, wild grass, etc., and will be so stiff that the ordinary plow will not turn it over. There are a number of plows made for this purpose with long mould boards that turn the furrow over gradually and completely. They are generally all steel with a steel point that cuts the full width of the furrow to be turned, and with either a standing cutter or a rolling coulter, or sometimes with both. All of these should be kept as sharp as a knife and bright, as there is nothing in the soil to scour them. Some of the disc plows can be used in breaking new muck if there are not too many big roots. Lately the Spaulding deep tilling disc plow has given excellent satisfaction. Many new areas are being plowed

with this new plow to a depth of 12 to 16 inches.

Muck Shoes.—If the ground is soft it may be necessary to use muck shoes. There are a good many different kinds, but the best are the iron ones concaved on the lower side, with holes in the bottom for the calks of the horse shoes to fit into and with adjustable clamps coming up over the front of the hoofs. These clamps when bolted together hold the shoe firmly against the foot, and the calks prevent it from slipping. The concave lower side of the shoe holds firmly on the ground and prevents slipping, and it does not seem to sink into the ground as easily as a flat shoe. These shoes seem clumsy at first, but the horse soon learns to handle them and has more confidence with them on.

Another Method.—A method that is sometimes used in soft ground to avoid walking the horse in the furrow is to make a truck to which the plow is attached. This may be done by taking a piece of heavy, sound timber for an axle and fitting a heavy tongue to it, bracing it firmly so that it will be perfectly rigid. On the right hand side

(if a right hand plow is used, and most of the plows intended for this purpose are right hand), place a large wheel, and on the other side a small one. The diameter of the large wheel should exceed that of the small one by twice as many inches as the depth of the furrow. This will make the truck run level

Fitting Land with the Spike Tooth Harrow

when the large wheel is in the furrow and the small one on the land. To the axle of this truck and to the right of the tongue is attached a clamp to which the plow is attached. This clamp should be made so that it can be moved along the axle and also so that the point to which the plow is attached may be moved up or down.

Four or six or even eight horses are used with this arrangement. The team next to the plow is hitched as to a wagon. On the end of the tongue a hook is attached, to which the next team is hitched; more teams may be used by continuing the tandem arrangement forward with chains for the draft. A large plow, one that will cut off and turn a furrow from 20 to 24 inches wide, works best.

The large wheel of the truck is intended to run in the furrow and to be held right up to the land. The distance the clevis or clamp on the axle is placed from the inner side of the rim of the wheel determines the width of the furrow, and this width should be the width the plow is intended to cut off. The clamp, being set to the right of the point where the back team is pulling will cause a side draft, but this is overcome by the next forward team, which is hitched to the hook on the end of the tongue. This team is driven a little farther away from the furrow than the one hitched to the truck. A very strong tongue of sound timber is needed.

The depth of the furrow is adjusted by

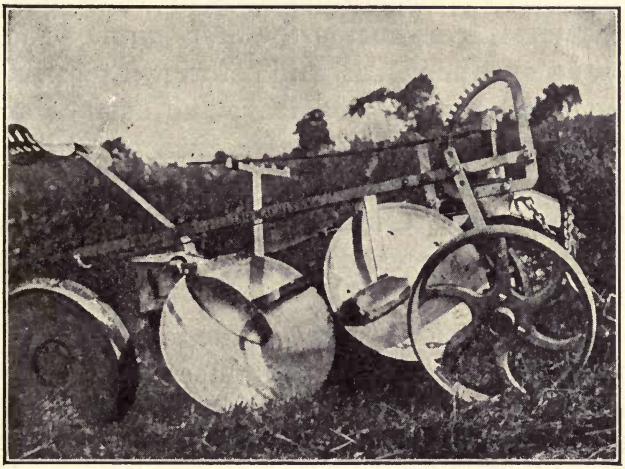
raising or lowering the clamp on the axle. A plow of this kind should be equipped with a standing cutter clamped to the beam, and extending to the full depth of the furrow, and braced against the extreme front end of the point. With the cutter kept very sharp and with sufficient power, roots 5 or 6 inches through may be cut off if they are firmly embedded in the soil. If they are not, they will be shoved out of the ground. If there is a stiff sod, it is sometimes well to use a rolling coulter ahead of the standing cutter.

In determining the depth of the furrow, a grower is governed by the depth to which the roots of the wild vegetation penetrate the soil, remembering that if these roots are very shallow the reason is that the lower soil is so sour that it will not sustain plant life. The best way to judge this is by the character of the wild vegetation. If the weeds are rank and with heavy stems and green leaves, it is pretty safe to assume that the soil is not very acid. If, however, it is stunted and consists of fine grasses and sphagnum moss, it is a sure sign of acidity.

If it is possible to do so without turning up sour soil, it is much more satisfactory to

plow to a depth of 10 or 12 inches, as with a wide, deep furrow, turned almost completely over and then rolled down with a heavily weighted roller, a great deal of the wild vegetation will be entirely smothered out and enough loose soil may be obtained for a good seed bed.

Fitting the Seed Bed.—After the land has



A Spaulding deep tilling plow used to break up new muck after the bushes have been mowed.

been plowed and rolled down, the roots and other rubbish should be hauled away and the ground fitted down with discs, alternating between the discings with a roller

and heavy plank float; always keeping the soil packed down as firmly as possible. A 24-inch disc is a good tool for the first fitting, following up with a double action cutaway for leveling and smoothing the surface soil.

It is possible to get the ground into condition to grow celery or even onions the first season, but the better way is to keep working it over during the first summer and killing out the weeds, and before winter give it a good discing and leave the surface as loose as possible, so that freezing and thawing may have a chance to get in their work. In the spring the surface soil should then be mellow and most of the perennial weeds killed out.

An application of lime in the fall will help mellow the ground and will offset the acidity that exists and that which will subsequently be put there in commercial fertilizers. No two pieces of muck present exactly the same conditions, and a liberal amount of perseverance with common sense and ingenuity that will aid one in divising means to overcome unexpected obstacles are the best assets in beginning an undertaking of this kind.

Windbreaks.—When large bodies of muck are cleared, it has been found that great damage is often done by sweeping winds. Sometimes the top dry layer of muck with seeds or crop is completely blown out. It is then necessary to grow or erect windbreaks to check the force of these disastrous winds. At Canastota, N. Y., poplar trees have been grown for this purpose, placing them 1 rod apart in the row and generally around a 5 or 10-acre lot. The trees have grown finely. At South Lima, N. Y., cedar is used by some. Others use slat fences with good success. The latter does not waste as much land as the former. At Middleport, N. Y., one company uses black currants on their muck. They have proved both satisfactory as a windbreak and profitable as a crop producer, about $600 worth of currants being harvested in 1912. Other forms and kinds of trees, shrubs, or fences, are used in various places. The main factor in each case is to place some obstacle in the path of the wind to check its devastating effect.

First Crops.—After the muck has been plowed and fitted, it is very seldom advisable to plant the ground to the more delicate

crops such as celery and lettuce, nor, as a rule, are good onions raised the first year. The best practice is to grow corn or potatoes the first year, and if the muck is in good shape the following spring, some of the other crops can be grown. If the muck still needs some subduing the second year, better grow the other crop—if corn the first year, potatoes the second, or vice versa.

A man with limited capital should always go the longest but safest way in cropping muck. A word of caution is pertinent at this time. Go slow at the beginning, know the conditions by feeling your way before you speculate. Muck is a different proposition from any other form of farming.

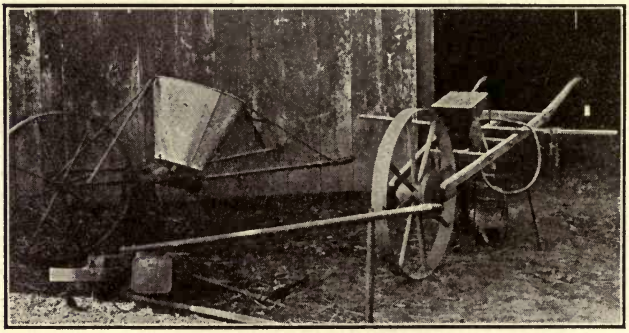
CHAPTER V

CROPS GROWN ON MUCK SOILS

Asparagus—Asparagus is one of the crops not commonly grown on muck, but, where it has proved possible to grow it, has yielded "grass" of the highest quality and largest size. Muck for asparagus **must** be very well drained. Any standing water remaining over the land for even a short time will cause the roots to be drowned out, thereby practically ruining the bed. Shallow muck near the edges of a large muck area has proved satisfactory, especially where the water table is low, because it is never flooded or water-logged.

Varieties—Purchase the choicest seeds of such varieties as Conovers Colossal, Palmetto, Giant Argenteuil, Barr's Mammoth, or the new rust-resistant sort, Reading Giant. These large growing types will give very large "grass" when grown on muck.

Seedlings.—Sow the seed sparingly in rows, having the rows 12 inches apart. Give good cultivation throughout the season. Apply 500 to 1000 pounds an acre of a complete fertilizer, such as a fertilizer containing nitrogen, phosphoric acid and potash in the ratio of 3-7-10 or 4-8-10 to the bed as soon as the seedlings come above the ground. One or two applications of nitrate of soda, 100 to



Muck Tools—At left, McWhorter Fertilizer sower. At right, Arlington Seeder. Centre, Planet Jr. Seeder.

150 pounds an acre, or 300 to 400 pounds of fish tankage, as a supplementary food supply, will force the seedlings along. Dig the roots for transplanting early in the following spring. The size of the roots will be a surprise, as they should be as large as well-grown two year old roots.

Planting.—On the muck which has been selected, rows or furrows should be made. The distance between these furrows should be at least 4 feet. Some growers prefer even 5½ or 6 feet. Of course, the furrows should be straight. They should be from 8 to 12 inches deep. These furrows may be plowed out and slightly cleaned up with a shovel or they may be entirely dug with shovels or spades.

Place the roots of the asparagus in these trenches from 18 inches to 2 feet apart, with a small amount of soil under each crown, in order to have the centre of the plant slightly higher than the outside ends of the roots.

Natural Position for Growth.—Push over these crowns and roots 4 to 6 inches of soil. Press the same against the roots by walking on the soil. Later, by cultivating the trench will be filled. The reason for this depth of planting, 8 to 12 inches, is because the buds of the crowns come closer to the surface each year. Planting should take place as early as possible in the spring.

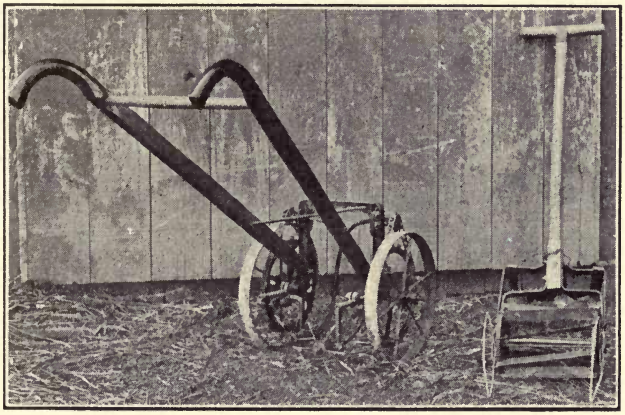
Care Following Planting.—As soon as the crowns have pushed forth growth, an application of fertilizer should be given to the bed,

from 1,000 to 1,500 pounds of a fertilizer with nitrogen, phosproric acid and potash in the ratio of 3-7-10 or 4-8-10 will do. Supplementary applications of fish tankage or nitrate of soda may be given later if the grower sees a need of the same. Yearly application of 1,500 to 2,000 pounds should be given, half the amount early in the spring and the balance after cutting ceases, July 4.

The asparagus plantation should be kept free from weeds throughout the season. Slugs may bother, but they can be controlled by spraying with arsenate of lead, 3 pounds to 50 gallons water. Rust is the only disease that gives much trouble. Spraying to correct this pest has not given satisfaction. The most practical means of control is to cut the tops and burn them quickly whenever the disease is noticed. The disease is a premature yellowing or rusting of the foliage. All of the foliage should be cut and burned in the late fall, in order to stop any chance of the spreading of this disease.

Harvesting and Marketing.—It is possible to cut a larger amount of "grass" the second season from planting than would be practical where asparagus is grown upon other soil

types, the reason being that the "grass" grows faster and larger on muck than it does elsewhere. In cutting, insert the knife in the soil deep enough to cut a stalk of fair length, from 9½ to 11 inches. Be careful not to cut too deeply, as this injures the roots or crowns. As asparagus is still con-



More tools.
Left: Vorman onion weeder.
Right: Weeder and mulcher.

sidered a luxury by many city consumers, it will pay to grade the "grass" and put it on the market in the most attractive form. Group the stalks by sizes together, extra large, large, and culls.

Some growers have found it an advantage to tie the bundles with red or white tape.

The tape is inexpensive, and it certainly adds to the appearance of the bunch. The bunches should be 9 to 9½ inches long, and the average weight of a small bunch is 1 pound, large sized bunch 2 to 2½ pounds. During warm growing weather, it will be necessary to look over the bed every other day and sometimes each day, in order to catch the shoots before they become too long for marketing. Some growers remove shoots Saturday afternoon, in order to avoid cutting on Sunday. The shoots are then washed and bunched and stood in shallow trays, butts down, in about a half inch of water. This is a good method to keep over asparagus, even for a few hours.

Yields, Costs and Returns.—From 8,000 to 10,000 pounds of grass should be cut from an acre of well grown asparagus on muck. A fair price for the "grass" is 5 to 8 cents a pound. Some men average 10 cents. It will cost from $75.00 to $125.00 dollars to plant an acre of asparagus and about $150.00 dollars an acre a year to handle the crop. It is one of the most profitable crops on muck if the water conditions of the soil are correct.

CHAPTER VI

BEETS

For the best development of garden beets, a cool, rich situation is needed. Such a location is found in muck soils.

Varieties.—The same varieties that are common to garden soil are useful on muck. Extra early production is generally not possible, as muck is not as early as some other soils. Crosby Egyptian and Eclipse are good early sorts for muck. Edmunds and Detroit for the main crop seem to give the best satisfaction.

Preparing.—The land may be plowed or disced for this crop, followed by being harrowed with a spike-tooth or some other type of a smoothing harrow. The planker should be used after harrowing, leaving the muck smooth and level and somewhat compacted.

Planting.—The seed is sown in drills, using from 5 to 7 pounds of seed to the acre. The rows are generally 12 inches apart for man working, or where horse culture is to be

used, from 24 to 30 inches. The seeding should not be too thick, 10 to 12 seeds to the foot being enough. One inch of covering over the seed in this soil is about right. Germination is generally prompt and growth should be rapid.

Table Beets raised in muck, Syracuse Gardens Co. Yield 17.4 tons per acre.

Care of Crop.—The amount of fertilizer to use on this crop should be large enough to insure rapid growth. From 1,000 to 1,500 pounds an acre of a fertilizer with nitrogen, phosphoric acid and potash in the proportion of 4-8-10, with a later application of 300 pounds fish tankage or nitrate of soda, should keep the plants growing correctly. The fertilizer should be broadcasted, first at the time of sowing the seed and later as the crop indicates its needs.

Clean culture should be practiced at all times—no weeds. The cultivation should be shallow, as the beet is a surface feeder. Thinning will be necessary, in order to get the best yields. Two to 2½ inches between plants is enough. If the beets are to be grown for canning, no thinning is needed, as the canneries generally want small beets.

There are practically no insects that bother beets, although the leaf miner is troublesome at times. No remedy. The leaf spot, a disease, probably shortens the crop somewhat, but very little attention is given to it. Bordeaux 4-6-50 sprayed on several times may prevent it somewhat. Scab, similar to the disease of the same name on potatoes, is found on beets. The best remedy is to grow the crop on soil not infested with the scab fungus, in other words, rotate your crops.

Harvesting.—The beets are pulled by hand and topped. Topping consists of cutting the leaves about an inch above the crown, the roots being placed in crates and sold at once; or they may be placed in storage, to await a more advanced market. Sometimes the beets come early enough to be pulled and bunched without topping.

The canneries require beets topped and not very large roots.

Marketing and Yields.—The crop may be sold direct from the field to canneries or stores or sent away on commission. Beets sent away should be packed in baskets, boxes, crates or barrels, according to the market's demand. The root should be somewhat free from dirt.

Yields and returns vary with this crop. From 300 to 500 bushels an acre is quite common, while a large yield would be 600 or 750 bushels. Returns of $125.00 to $400.00 or even $500.00 may be obtained. The cost of producing a crop is from $60.00 to $75.00 an acre.

Cow Beets or Mangel Wurzels.—The cow beet has many of the same characteristics and requirements given for garden beets. However, these requirements vary somewhat. Distance between rows is 18 inches for man tillage and 3 feet for horse culture. Plants should be thinned to not more than two to the foot. Larger roots will be obtained if but one plant remains in each foot of row. For fertilizing, 500 to 750 pounds is enough of a fertilizer containing 2% nitrogen, 8%

phosphoric acid and 10% potash. The remaining cultural directions are the same. Yields are much larger, being from 800 to 1,200 bushels or even more. Many times these beets are grown near the windbreak where celery, onions, or lettuce will not grow successfully. It is then seen that a crop of some sort is returned where otherwise little or no return would be forthcoming. Mangels grown for feeding are worth from $2.50 to $3.00 a ton, and 20 to 35 tons an acre can be raised at a cost of $35.00 to $40.00. There is then a small profit from this crop.

CHAPTER VII

CABBAGE

Although cabbage is not a common crop grown on muck, it can be grown very successfully. Muck deposits furnish exactly the requirements demanded by cabbage—a cool, moist situation, particularly affording the condition of a constant moisture supply.

Varieties.—It is not advisable to try to grow early varieties, because muck soils are not of the early type. Such varieties as Danish Ball Head, Volga, Flat Dutch, All Season, Succession, Houser and many others of the midseason and late sorts are the kinds to grow.

Some care should be exercised to secure seed from growers or dealers who have relatively high-producing strains. The Pennsylvania station gives the results of several years' tests of strains of different varieties, showing a marked difference in the yielding qualities of any one sort from different sources. Buy none but the best tested seed.

Preparing the Muck.—Cabbage would be a good crop to follow onions or lettuce. Any crop that has different characteristics of growth may precede. The soil for cabbage may be plowed or harrowed, followed by being fined with a smoothing harrow. A planker should then be used, in order to compact the muck somewhat. It also leaves the muck in fine condition to mark out.

Planting.—Plants may be produced by sowing the seed in the muck, first preparing a small piece of ground for the seed. The rows should be about 10 to 12 inches apart, and the seed should not be sown too thickly. Four to six plants to the inch can be produced satisfactorily—more may cause spindling. It is important to have good stocky plants for transplanting, therefore, give each room enough to grow correctly. The time of sowing is any time in May, transplanting to the field six or eight weeks later. Houser and Danish Ball Head should be started about May 1, for the best results. The seed should not be planted deeper than ½ to ¾ of an inch, as the moist soil will practically insure correct conditions for germination. A half pound of seed should give plants enough to plant an acre.

The muck can be marked out with a celery marker, or furrowed out with a plow or any other tool. Transplanting should follow immediately after marking. For the mid-season varieties, 18 inches in the row and 30 inches between rows is about right, while late varieties need more room, 24 to 36 inches in the row and 36 to 42 inches between rows. Give them plenty of room as the plants will grow larger on muck and close planting is rather conducive to small heads.

Transplanting should be quickly and easily done. If the celery marker is used, all that is needed is to place the roots of the plants in the marked furrow the required distances apart and press a little moist muck against them. Then another plant, and so on. A good active man or woman will set several thousand plants during a day.

Transplanting machines are not used to any extent on the muck, because their great advantage, that of supplying water to the roots, is lost in the moist muck, and also because of their expense and the fact that hand work can be so speedily performed in this class of soils.

Fertilizer.—The demands of cabbage for food are relatively heavy. In a normal crop

of 14 tons an acre, a large proportion of nitrogen and potash is removed. Sixty-seven pounds nitrogen, equivalent to a fertilizer analysing 8% nitrogen; 114 pounds of potash, equivalent to a fertilizer analysing 14% of potash; and 23 pounds phosphoric acid, equivalent to a fertilizer analysing 3% phosphoric acid are removed. These

Planting cabbage in muck, using a line to keep row straight.

amounts, however, do not fully suggest the proportions needed. For practical growing, a basic fertilizer of the 4-8-10 formula, about 1,000 to 1,500 pounds an acre, supplemented by one or two applications of nitrate of soda or 300 pounds fish, will give satisfaction.

In some cases, less fertilizer is necessary, in particular if following a crop that has been fertilized with a ton to a ton and a half of a high grade complete fertilizer. Probably 500 to 750 pounds of the above applied to the cabbage would be sufficient.

Broadcasting the fertilizer by hand or machine and harrowing in seems to be the best method of application. The supplementary applications may be given after the plants have become established and again at the time of heading.

Care During Season.—As soon as the plants are set and show from their erect position that they have "taken hold," cultivation can begin. Frequent cultivation as late as possible should be given throughout the planting season.

Insects.—The aphis or louse is very bothersome some years. Heavy rains tend to check the pest somewhat. Applications of nicotine sulphate if sprayed on the cabbage, will undoubtedly kill large numbers of these insects. Have a fine sprayer equipped to throw the spray out under 100 pounds' pressure. Repeat applications several times, because once over will not hit all and they must be hit to be killed.

Cabbage Worm.—A greenish larva, the young of the whitish-yellow butterflies that are so common everywhere, eat the leaves of cabbage. Apply poison to leaves during early stages of the cabbage's growth. Three to 5 pounds arsenate of lead to 50 gallons water will be most effective. After the heads of the cabbage form, **do not** use poison sprays. In fact, spraying is about useless at and after this time. Therefore, spray early and kill all of them.

Diseases.—Club root, an unnatural growth on the roots, causing them to be distorted and enlarged, spoken of also as club foot or clump root. It often appears in the seed bed and infects whole farms if the seedlings are planted out in the field. Therefore, care should be taken not to plant seed on infected land. Affected plants show the trouble by wilting quickly on warm days and by unthrifty growth.

The disease is found in the following cultivated plants: Cauliflower, turnip, brussels sprouts, kale, radish, kohl-rabi, rutabaga turnip and mustard, and on weeds such as wild mustard and shepherd's-purse.

The remedy is to lime the soil to correct acidity, as the disease thrives best in an acid

soil. Use 75 to 100 bushels stone lime an acre. Keep all such crops away from land for five or six years, as the disease will live over several years in the soil. All diseased parts of plants should be collected and burned.

Other diseases of the cabbage are less common and notice of them will not be given here. Growers interested in other diseases of the cabbage are referred to other books on cabbage growing published by Orange Judd Company, 315 Fourth Avenue, New York City.

Harvesting and Marketing.—In harvesting cabbage, the operator strips down the outside leaves by striking them with the hand. A knife such as a butcher knife or square blade is inserted against the stem close to the base of the cabbage head. At the same time, the head is bent toward the knife, thus aiding in the ease of severing the head from the remainder of the plant. The head may be turned upside down as the blanched base will attract notice later when it is to be collected, or it may be placed in a basket, box or barrel. The cabbage is now ready for marketing.

As muck cabbage, as a rule, does not head as firmly as cabbage grown on loamy soils, it is generally best to sell it directly from the field. It may be collected directly from cutting in a wagon, care being taken not to handle it roughly, and carted loose to the car, or if market conditions warrant, it may be barreled and shipped in that manner. As a general rule, it is sold loose by the ton and in car lots if the acreage is large enough.

The heads are generally very large, often being 12 to 18 inches across and weighing from 5 to 8 pounds or more. They are particularly valuable for sour krout.

The average price for a number of years demonstrates that cabbage is a good crop to grow. Average for 10 years shows that cabbages brought the following prices by the ton:

November	$ 7.20 to $ 9.30 a ton
December	9.00 to 11.70 a ton
January	13.10 to 15.70 a ton

Yields, Costs, Net Returns.—From 12 to 25 tons an acre are obtained. An average of 12 to 18 tons would be very good. More is obtained by having good seed, good plants, plenty of plant food and good care during the growing season.

It costs to raise this crop about $40.00 to $60.00 an acre, leaving a net profit of $30.00 to $100.00 an acre. Larger returns are obtained some years, and less, even a loss, may be expected sometimes.

CHAPTER VIII

CARROTS

The requirements for the best development of carrots are a loose soil, fairly rich, and at the same time a soil that does not "pack" over the seeds. Muck soils fill these conditions. Probably the smoothest roots are produced in muck, also the largest yields.

A one row marker. The band of iron in large wheel marks the row.

It has been found, however, that some crops such as lettuce and celery do not do well following a crop of carrots. It would be well then to have some other crop such as cabbage, cauliflower, potatoes or sweet corn follow a crop of carrots. This crop is often grown near the windbreak on land not valuable for celery,

lettuce or onions, owing to the shading and soil robbing caused by the trees growing in the windbreak.

Varieties.—Probably all varieties of carrots would do well on muck. However, but three have been tried out sufficiently. They are Danvers Half Long, Chantenay, and Oxheart. During the season of 1913, which was notably dry, the author had the privilege of watching one of the finest crops of Danvers Half Long which he has ever seen. The crop on maturity was snapped up quickly by one of the large soup canneries.

Preparing the Muck.—Preparation does not differ much from any fine seedling crop. The muck should be plowed or disced, afterwards being "fined" and either rolled or, better, planked. Every tendency in muck work is to have the soil fine but still somewhat compacted.

Planting.—The seed is immediately drilled in, using any of the good wheeled, manpower planters. May 1, to 15, is the time to plant. The rows are generally 12 inches apart, and the seed is planted from ¼ to ½ inch in depth. About 3 pounds of seed are needed to plant an acre. The seed germin-

ates slowly, but in 10 days or two weeks it can be observed coming through. It will be necessary to thin the young seedlings when they have grown to 2½ inches in height, spacing them 2 to 3 inches apart.

Fertilizer.—Medium applications of high grade fertilizer give satisfactory returns with this crop. Fertilizer of a lasting nature should be supplied, a tankage base in preference to all minerals. From 750 to 1,000 pounds of a fertilizer with nitrogen, phosphoric acid and potash of ratio 3-7-8 or 4-6-10 will be found valuable. Much depends on the crops preceding. Celery, lettuce or any crop receiving a ton or more of fertilizer the year previous would necessitate practically the cutting down of the application for carrots, the lower amount suggested or even 500 pounds being economical enough.

Cultivation.—During the early stages of the crop and as long as the growth allows, clean cultivation with wheeled hoes or shuffle hoes should be given. Later, if cultivation cannot be given, hand pulling of the large weeds will be necessary. All cultivation should be shallow. About two finger weedings will also be necessary, probably the first

at the time of thinning and one about a month later.

Insects and Diseases.—There seems to be no troublesome pest, and therefore, spraying is not necessary.

Harvesting.—The muck is generally so soft that it is possible to easily pull the roots out of the soil. The tops should be removed and the roots placed in receptacles for marketing. Washing the roots is not necessary, as the muck, when dry, falls off, leaving the roots clean.

Marketing.—Where the crop is sold to a canning factory by the ton, the carrots are first placed in onion crates, care being exercised to cull out the smaller roots. Sometimes they are passed over an onion screen, in order to grade and clean them. From these crates, the roots are dumped into the car or on the platform of the factory. They should be weighed in the presence of the grower by the purchaser.

Where carrots are sold locally, they will have to be placed in boxes or crates and taken to the stores or markets, the carrier often being returned to the grower. Carrots shipped to large cities are usually sent in

bags or loose in the car. A grower wishing to ship to any market should write to the city for the requirements regarding the package to be used and the size of roots wanted.

Storage.—Several of the large muck men own storage plants and place the carrots in them when the fall price is low, $9.00 or less a ton. Later the carrots are sold as the market "cleans up," often returning from $20.00 to $25.00 a ton.

Carrots may be stored in the muck if good drainage is available. Make a conical pile of carrots on the muck about 3 feet wide at the base and of any length. Throw muck as a covering over this pile, at first about 3 inches deep. Later, as cold weather comes on, more muck is needed. Sometimes a covering 12 to 15 inches is necessary. The carrots can be removed as wanted, beginning at the end of the pile.

Yields, Cost and Returns.—It is not hard to produce 800 to 1,000 bushels of first class carrots to the acre. More have been produced. Every grower has been surprised at the yield, size of roots and the clean straight character of their growth.

It will cost from $55.00 to $75.00 an acre to mature and market an acre. Where several acres are grown, the cost will be somewhat less. About $9.00 a ton seems to be the average price in the fall. By holding in storage, a higher price is generally received. Locally 50 to 60 cents a bushel is paid.

Gross returns are quite constant, as this crop is not very difficult to obtain, nor do the markets fluctuate greatly, from $150.00 to $180.00 an acre being received. The net should be about $125.00 to $130.00.

CHAPTER IX

CAULIFLOWER

Cauliflower being one of the family of cole crops and, therefore, similar to cabbage, it would naturally have many requirements similar to cabbage. A cool, moist climate is needed, as well as a constant and liberal supply of water. Average years muck locations supply these conditions. Cauliflower is a more difficult crop to grow than cabbage. It is less hardy and more exacting in many details. Frosts or poor seeds or checks in growth often spoil the crop, as it will "bolt" or run to seed. When properly grown, the plants and heads are much larger than when grown elsewhere, and the quality is equal to the product of other locations or superior.

Varieties.—The Snowball has been the standard up-to-date. However, the Dwarf Erfurt is fast pushing it for first place. Both of these varieties may be used for both midseason and late crop. There are two

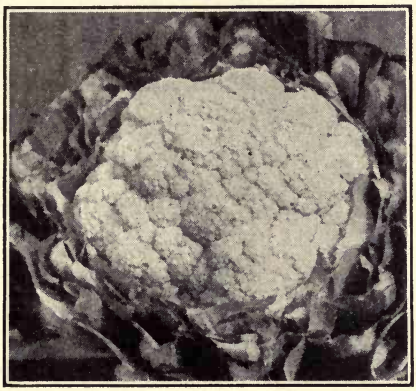
other sorts that are good for late use, Autumn Giant and Algiers.

Seed.—Most of the best seed comes from Denmark. Remarks found under cabbage seed apply equally as well here. As the cost of cauliflower seed is so high, even more care should be exercised to have the choicest seed obtainable. About $8.00 to $10.00 an ounce is not too much to pay if the seed will produce what the grower wants. An ounce of seed should produce from 2,500 to 3,000 plants.

Growing the Plants.—The early planting takes place in a forcing structure such as a greenhouse, hotbed, or cold frame about March 1 to 10. Care should be given not to over-water, as the plants are quite subject to the damping-off fungus. These early plants should be hardened off and ready for transplanting outside by May 1 to 15. The plants will then have sufficient time to get their best growth during the moist days of early summer.

For a late crop, the seed can be sown May 1 to 15 or a little earlier, the seed being sown in rows in the muck. Rows 12 inches apart, with the plants not too thick in the row—

from four to six plants to the inch of row—are about right. These plants should be ready for transplanting June 25 to July 10. They require more care in the seed bed than cabbage. A little complete fertilizer applied to the seed bed seems to help. A fertilizer of nitrogen, phosphoric acid and potash in



Extra choice Cauliflower can be grown in muck. The head of a crop which was selected as the best crop in 1914 in N. Y. State.

the following respective proportions, 3-7-10 or 3-7-8, at the rate of 750 to 1,000 pounds to the acre, will do.

Preparing and Planting.—Preparation of the muck for planting is similar to that men-

tioned for cabbage. The rows should be about 30 inches apart if horse culture is to be used and 24 inches apart for man working. Plants should be spaced about 18 inches apart in the row.

Marking out and placing out the plants in the furrows are preformed as for cabbage. Some men think it best, where both the cauliflower and cabbage are "pulled" from the plant bed with but little valuable root growth, to balance this condition by shortening in the top, either by removing two or three leaves or by tearing or cutting off a portion of several leaves. This cutting back seems to aid the plant to renew its growth more quickly.

Fertilizer.—Cauliflower demands a richer soil than cabbage, and it is, therefore, necessary to apply heavier amounts of fertilizer where this crop is to be planted. From 1,500 to 2,000 pounds of a 4-8-10, supplemented by one or two applications of 150 pounds nitrate of soda or 300 pounds fish tankage, should give excellent results. A fertilizer with nitrogen, phosphoric acid and potash in the following proportions, 3-7-8

or 3-8-8, with supplementary nitrogen applications, has as well given satisfaction.

Lime, in order to help counteract club root tendencies, has met with general favor, a ton to a ton and a half of air-slacked lime being used. Both the fertilizer and the lime should be broadcasted, except the supplementary smaller amounts, which may be applied rather close to the plant. All should be harrowed or cultivated into the soil.

Cultivation.—Clean culture is absolutely essential, using shallow working tools such as the wheeled hoes or small tooth cultivators. Cultivate often in order to bring about the condition required for the best growth of this crop.

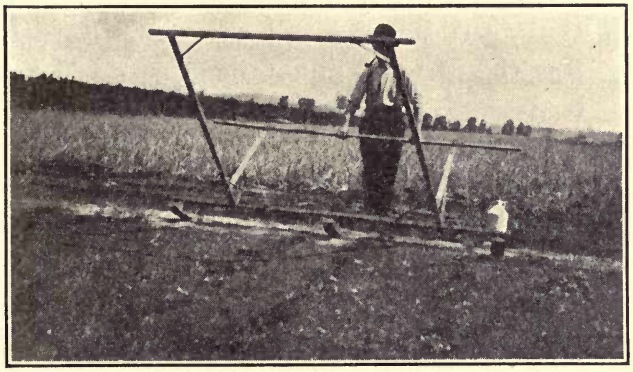
When the coral-like heads begin to form, care should be given that they are not burned by the sun, thus losing their marketing value. The coral may be protected from the sun by bending the leaves over the head or by tying the leaves in a cluster over the head. When the heads are forming, it will be necessary to go through the patch every other day, sometimes each day, to tie up new plants and to watch those which are tied up.

Insects and Diseases.—The insects and diseases common to cabbage are also troublesome pests on the cauliflower. Spraying with poison should cease when the coral forms.

Harvesting.—Watch the growing heads of coral very closely after they have been tied up, as they sometimes spoil or grow too large. Heads 6 to 9 inches sell the best. The head is severed from the plant with most of the leaves. That means cutting the stem 3 to 4 inches below the coral formation. The leaves are then trimmed off just below the widest part of the coral, leaving a most attractive vegetable with the white coral centre and a fringe of green all around its edge.

In cutting the leaves, the knife is not held at right angles to the coral but at more of an obtuse angle, with the point of the blade below the coral and cutting the outside leaves farther up on the blade. Hold the head in the crook of the arm and insert the knife, moving the head as needed. Practice will soon help one to acquire the knack. Cauliflower is a tender vegetable and should be handled carefully.

Marketing.—The heads may be packed in a bushel box, six heads or less in each. Special crates are made for this crop, the heads being placed in these, coral out. A small piece of clean white or cream paper is generally placed over the coral to protect it from harm. Do not place this choice vege-



A three row man-power marker. Used for Celery mostly.

table in barrels, especially the dirty, second-hand barrels used by some cauliflower growers, as the delicate, coral-like flower loses all its attractiveness and purchasers are, therefore, not practically forced to buy.

Sometimes where cauliflower is to be shipped to market, it is placed in crates, sur-

rounded with excelsior, thereby checking any "play" or injury in carriage.

Yields, Costs and Returns.—The yields are variable, being sometimes very low. A good average crop would be 7,000 to 10,000 heads per acre. Where sold to the stores or market, the price received is from 4 to 25 cents a head. In larger amounts 60 to 85 cents a dozen is a fair average. Returns of less than $100.00 have been received and as large as $1,000 an acre, the gross receipts varying as much as the yield.

A grower on muck soil in western New York says: "When the first of our cauliflower matured, the heads were very large, and sample crates sent us from Buffalo for shipping cauliflower were found to be so we could not get our cauliflower in them. So I made a few crates especially for the purpose. They were quite long, and would just hold a half dozen heads. Those sold in the Buffalo market for $1.50 a crate. But the market soon went right down."

An average price gross return of $400.00 to $500.00 an acre would be very good. Some growers are satisfied with $200.00 to $250.00 an acre.

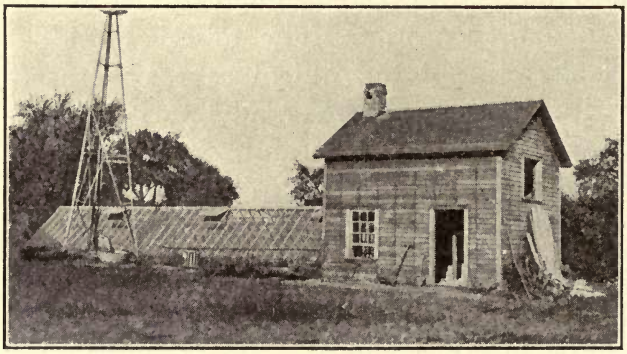
CHAPTER X

EARLY CELERY

First class muck for celery should be of a brownish-black color. If too light soil, it does not seem to give as good results as that of a darker nature. The muck should be friable and not too full of coarse pieces of wood. It seems to be an advantage to have the soil neutral. Therefore if the soil responds to an acid test, it might be necessary to apply lime, from one to two tons an acre. The soil should be at least 12 to 18 inches deep for the best growth of this plant. Where the soil is shallow, oftentimes the plant suffers during the drought. The water table should be about 3 feet below the surface. If shallower, water often covers the celery, especially during the rainy periods, causing the roots to drown out. If the water table is deeper sometimes water deficiency during droughty periods results.

Five of the most important reasons why a soil as mentioned above is especially adapted to celery follow:

1. Because these soils would be relatively moist.
2. Because these soils would be fertile.
3. Because these soils would be loose.
4. Because these soils would be friable.
5. Because, being friable, they are easily worked, thus reducing the cost.

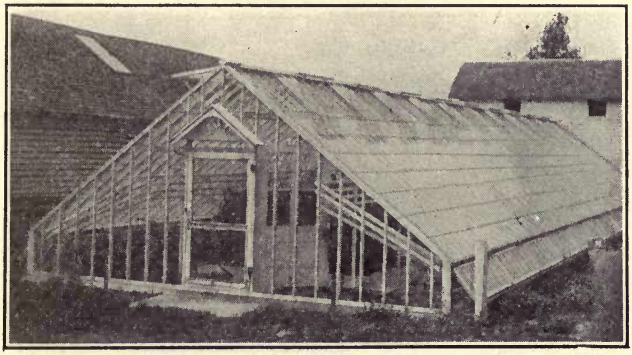


The greenhouse and plant shed at Sunset Farms.

How to Start Plants.—A small greenhouse or hotbed should be available for forcing the early plants. The soil contained in these forcing structures should be of a mucky nature similar to that where the plants are to be placed outside. The seed may be planted

in this specially prepared soil in one of two ways: In rows 2 inches between rows, where the seed is placed in small furrows, the furrows not being more than ¼ inch in depth.

The other method is to broadcast the seed over the surface of the soil. With the last

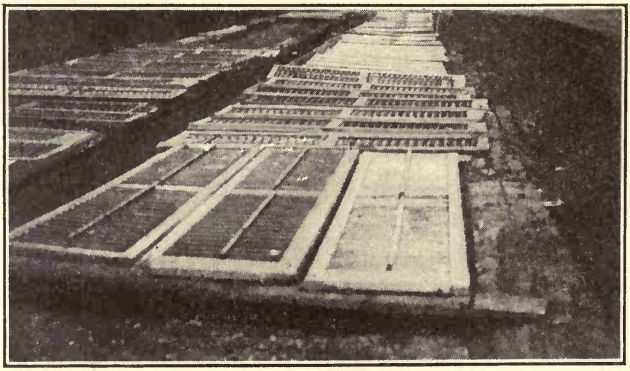


Greenhouse of C. C. Mowris, So.Lima, N. Y., 25 x 65 ft. Will raise 180,000 celery plants worth $2.50 per thousand.

method, the seed may be fresh from the package or it may be soaked. The way to soak the seed is to place an ounce of seed in about 2 quarts of fine muck. The latter should be the muck that passes through a fine sieve. Keep the combined muck and seeds thoroughly moistened and hold the

same at a relatively high temperature. About 75 degrees seems best. Stir the soil and seeds each day. The seeds will sprout very soon.

When little sprouts are noticed, the whole mass is sown evenly over the beds. Other soil is scattered lightly over this prepared



A novel scheme used to raise large Celery plants, railroad of ties as boundary, old blinds as a shade, at Paul Griener's, Canastota, N. Y.

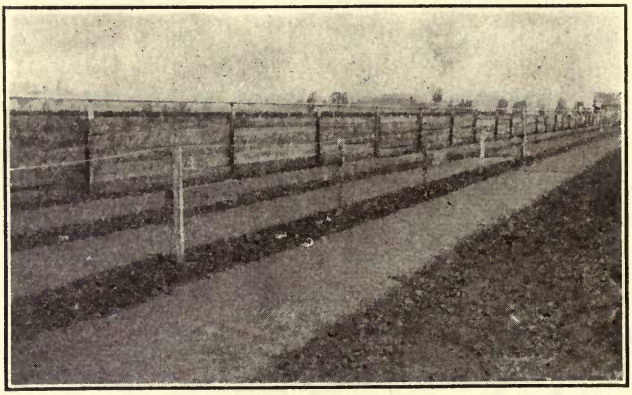
mass and all pressed gently downward. In the case of seed broadcasting, a slight application of soil can be sifted over the seeds and the whole mass firmed slightly with a board.

When the seedlings break through the ground, some attention is necessary, es-

pecially if an uneven seeding has been given. Where the plants are too thick, they should be thinned. Sometimes it is well to wait until the seedlings are a half inch in height and then transplant to the thin spots in the bed. Where the seed is sown in rows, thinning is not advisable until they are at least ¾ to 1 inch in height. They may then be transplanted to cold frames or merely thinned out in the row. It seems best to have from ¾ to 1 inch space around each seedling for its best development. It is important to give heat to these young celery seedlings, as they require the same heat for their most rapid growth as do tomato seedlings.

When very early celery is desired, it is wise to transplant from the greenhouse to a cold frame, having the celery spaced in the cold frame 3 inches between rows and 2 inches between plants in the row. The soil in the cold frame should be muck, the same as in the other forcing house. When the plants in the cold frame are 5 to 6 inches in height, they should be removed with a large ball of root and muck and placed in the outside ground. They will then produce earlier celery than by using most other methods.

The celery can be taken direct from the greenhouse or hotbeds after some attention has been given to hardening the plants by increasing the amount of air and lowering the temperature somewhat in these houses.



Early to mid-season Celery seed bed, Skinner irrigation. Board wind break.
Photo by C. E. Dimon.

Just before the plants are taken to the field, in some cases even two or three weeks before, it is advisable to spray with bordeaux to prevent blight. The bordeaux mixture will be mentioned farther on.

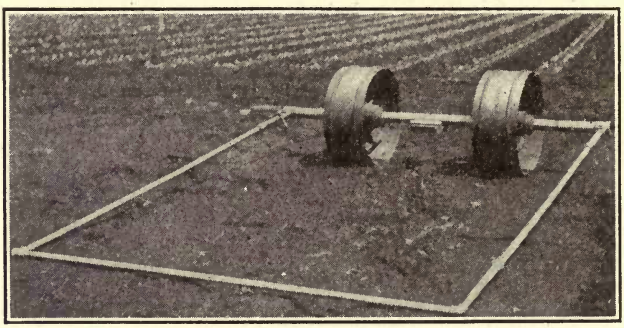
Sometimes in the greenhouse or hotbeds, the plants do not come along to suit. It would then be wise to apply a small amount

of nitrate of soda dissolved in water. A tablespoonful to 10 quarts of water is enough. One or two applications of this material will cause the plants to hasten somewhat.

Transplanting to Field.—The field where celery is to be transplanted should be well plowed, the earlier the better. The plowing should be followed by thorough fitting with tools that fine the soil and leave it level. One of the best tools for this thorough fitting is the Acme harrow. Following the harrow it is often advisable to use a planker. The planker will press the soil slightly and leave the surface very level and smooth.

Marking the Rows.—The marking out of rows follows. Some men desire to mark out double rows, then a wide space, the distance between rows varying from 7 to 9 inches, with the plants spaced 5 to 6 inches apart in these double rows and 2 feet between double rows. Another system is to make the rows 18 inches apart, with the plants 4 to 5 inches apart in the row. The latter seems to be the best distance, according to the most successful early celery raisers. However, the distance varies up to 39 inches between rows. Where the rows are 24 inches apart and the

plants are 4 inches apart in the row, 65,000 plants are needed for an acre; where the plants are 18 inches apart and the plants 4 inches apart in the row, 87,420 plants are needed to plant an acre.



Roller used for marking double rows. Double rows 30 inches apart, 6 inches between pairs. Photo by C. E. Dimon.

The plants are removed from the forcing structure, care being taken to remove as much root surface as possible. If deep trenches have been marked in the muck, the celery roots can be placed in the proper position, having all roots pointing downwards and sideways. The muck should be tightly pressed against these roots, the crown of the plant being just at the level of the ground. The plants may be placed in

marked rows with a dibber or trowel. Care should be exercised not to have the roots bend, as seemingly a poor plant results, especially where the roots form a "V." The transplanting should be done May 10 to 15, and then harvesting can take place from August 10 to 15.

Fertilizers.—From all indications a fertilizer containing 4% nitrogen, 8% phosphoric acid, and 10% potash, about 1,200 pounds to the acre, seems to give the best results, especially so if this amount is supplemented with 150 pounds nitrate of soda two or three times during the season. Some muck growers have found it advisable to use amounts larger than that recommended, even applying as high as 3 tons to the acre. The method of applying the fertilizer to the soil also varies.

In some cases, it is applied broadcast with a broadcasting machine or a fertilizer drill previous to planting. In other cases, it is applied with a drill each side of the plants; or from a bucket held in the crook of the arm, it is applied by hand between the rows. The fertilizer should be thoroughly harrowed in and incorporated with the soil. The supple-

menting of this regular fertilizer with nitrate of soda is carried on in several ways.

One good way is to open a small ditch with a man power wheel plow right close to the plants and apply the material by hand in this furrow, covering the fertilizer again with the aid of the plow. Another method is to use a fertilizer distributor, which applies the fertilizer each side of the row. It is then necessary to cultivate the fertilizer into the soil.

Hull Brothers, of Pennsylvania, have rather unique methods of fertilizing. They write:

"We have been growing celery on muck for several years, using commercial fertilizers entirely, excepting a load or two of manure as an experiment.

"Last year we applied the following to our three acres of muck for celery: 8 tons of 14% dissolved phosphate rock spread with shovels from stone-boat. Then this was harrowed in and 2 tons muriate of potash was sown and the soil planked ready for plants.

"After celery had been set about a week, we fertilized with dissolved nitrate of soda, using a sprayer and having a bordeaux type

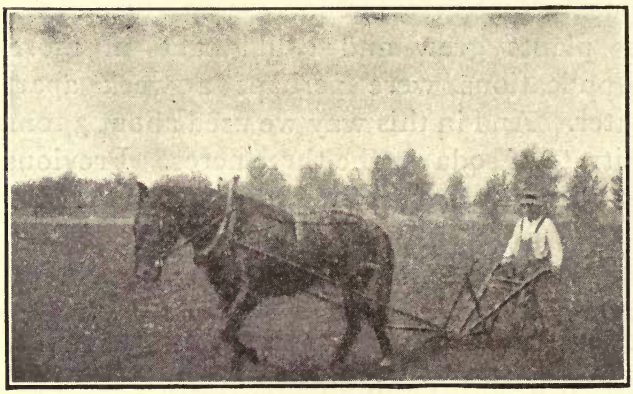
of nozzle, squirt, not spray, a small stream right over the roots on one side but not on the leaves. We kept increasing the application of this as celery grew, going over it every four or five days.

"After the plants were set about a month, we changed to the dry form of nitrate, using but little at first, but increasing all the time as plants grew and could take in more. Applications were perhaps a week apart later. And in this way we used about 3 tons nitrate of soda on the three acres. Previous to this, we used 2 tons dried blood and 1 ton of nitrate of soda, but we have decided that the cleanest types of fertilizers should alone be used on a plant which is so largely eaten in the raw state, so that we have dropped all organic fertilizers for this crop.

"We apply about a ton of lime to the acre every three years perhaps, planning to spread this on the soil at a different time from that at which the acid phosphate is applied, because we want the acidity taken from the soil, not the fertilizer. So we like to put the lime on in the fall. We have grown but very few cover crops on this soil, but it does not seem to need it yet, and then

those that live through the winter are hard to kill on moist soils.

"We are well pleased with the results of this plan, because we have been able to sell at wholesale a little over $3,000 worth of celery from the three acres each year for the last five years, and we are quite sure that it



Cultivating early Celery.

would have been more if irrigated, so that we installed an overhead irrigation system last fall."

Cultivation.—The plants should be cultivated often, and the work should not be made deep enough to do injury to the roots, as they come very close to the surface of the soil. At least five cultivations during the season are necessary.

Mulching.—In place of cultivating, a new method has been developed, that known as the mulching method. Manure is placed over this soil to the depth of 1 to 2 inches. Sometimes other material is substituted for

Early Celery—Rows 18 inches apart. Over 90% A1. stock. Board blanched field of Henry Greffrath, So. Lima, N. Y.

the manure—straw, leaves, or something else. This method, of course, will save in the expense of cultivation, especially if labor is scarce. The results seem to be satisfactory.

Irrigation.—There are at least four different methods of irrigating celery. In Florida the subirrigation with tile has been

practiced probably more than in any other section of the country. Here a main is laid at one edge of the piece and laterals every 20 feet running from this main. The water is turned on at one end of the main and made to go through the laterals by the process of gravity. From the laterals, the moisture reaches out through the land. In some sections of Florida it has proved very satisfactory; in other sections, it has not given satisfaction, owing to the fact that it is very difficult to force water through the soil, especially so where the tile are 20 feet apart and an attempt is made to force water evenly from one tile to the other. The cost of installation is relatively heavy.

One large portion of muck at Batavia, N. Y. has tile, but for irrigation purposes they have not proved close enough together; and this coming season the owner intends to place them a little nearer, hoping thus to increase their efficiency.

The furrow system is another type of irrigation which is practiced in a limited way; the water being allowed to run down between rows of celery. Of course, it is important to have good clean furrows and have

them spaced properly. Probably a lateral furrow would be necessary between every other row of celery. The end of this lateral furrow should, of course, connect with the main. Where a man has limited funds and a small area, it may be advisable to use this method, as the total expense consists of labor mostly. It has the disadvantage of requiring to be remade each year.

Flooding or something that resembles flooding results from the damming of the ditches, thus raising the water table, which causes the water to settle back and moisten the soil. It often results in great good to the plants where one is able to carry on this system of irrigation.

Overhead Irrigation.—Probably the most successful type of irrigation is that known as the overhead system, where a series of pipes are installed above the fields, one line of pipe every 50 feet. The pipes may be from 100 to 300 feet long or longer. In these pipes are installed nozzles which, under pressure, will cause the water to reach out 35 feet from the pipe line. The pipes are turned by man or automatic power, aided by

a specially constructed union. In very dry times, it is an advantage to apply about 1 inch of water to an acre every 10 days; for very rapid development of the crop results.

Diseases and Spraying.—It is necessary to spray celery from the very first. The celery is troubled by the early blight, Cercospora apii, and the late blight, Septoria peiroselini variety apii.

Celery in foreground, Onions in rear. Notice wind break of poplars in extreme rear.

Late Blight.—This disease is by far the worst one with which the celery growers have to contend. The general recommendations for control of this pest are to spray four or more times during the season. It

might be of interest to know a little more definitely just when these sprayings should take place, as well as other important matters concerning spraying.

As practically all the celery grown is started in a seed bed, it seems to be a very good idea to begin spraying while the plants are here developing. At least one spraying should be given before the plants are transplanted to the field from the seed bed, and it would help control the disease much better if two or more sprayings were given. The sprayings at this time will be quite cheap, owing to concentration of operation. Good sprayings will be very effective, as it will result in a condition on the plant that will not be receptive to the development of the fungus, owing to the presence of the spray material.

A third spraying should be given about four weeks after the plants have been set in the field. The time of this spraying will vary somewhat and should be governed by the moisture conditions of the soil, the weather, the size of the plants and many other factors. Enough to say new leaves, as well as old, should be well covered with the spray material.

The fourth and later sprayings will be governed by the growth of the plants and the amount of rainfall. In some cases, it would be advisable to spray every week throughout the growing period. Other times, owing to lack of rain, spraying would not have to be given more than once in four weeks.

Early Celery under Skinner system of irrigation. A perfect stand.

The Mixture.—Bordeaux is the fungicide most commonly recommended. There are in different localities slight variations in the methods of preparing this mixture. However, late experiments carried on by some of the leading stations have resulted in quite a uniform recommendation. The first step in preparing this mixture is to make up a

quantity of stock solution of both the copper sulphate and the lime. Accuracy in this work is very important.

If two 50-gallon barrels are available, place in each 40 gallons of water; in one barrel suspend a sack containing 40 pounds copper sulphate; do not allow the sack to rest on the bottom of the barrel, but keep it near the top of the water. In this way, the crystals of copper sulphate will dissolve quickly. Next weigh out 40 pounds stone lime, and after carefully slacking it by adding water (taken from the second barrel), a little at a time; pour into the other barrel. According to the preceding, 1 gallon of the stock solution will contain either 1 pound of copper sulphate or lime.

One of the most important points in mixing these two solutions is just how to put them together. It has been found after a long series of tests that the best bordeaux is obtained by first diluting separately the two solutions. The mixing should then follow while the two solutions are running into the spray tank simultaneously, allowing both to pass through a sieve 30-mesh to the inch, to remove coarse particles. The principal object gained by this attention to mix-

ing the bordeaux is that it will remain in suspension in the water a much longer time.

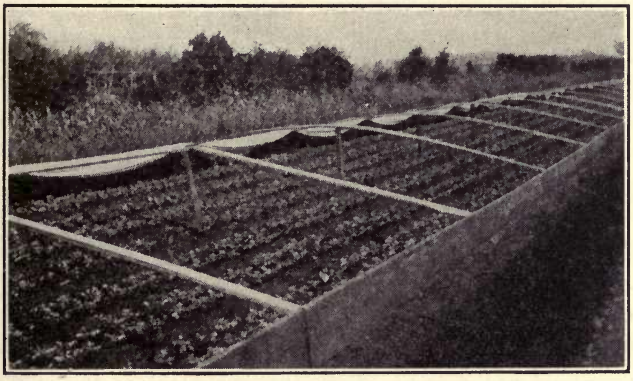
Still another important question is the strength of the bordeaux. Some experimenters recommend a 5-5-50 with a ferro-cyanide test. This test seems to me to be an unnecessary amount of labor and not a piece of work that would appeal to or be taken up by farmers or gardeners. Other experimentors favor a 5-6-50 solution. This is a step in the correct direction—more lime is added than required in the first—and this mixture may not require the bother of the test. However, it has been the author's experience that one more pound of lime would be a safeguard at a little or no added expense, and a solution of 4-6-50 or 5-7-50 would be one that would not require the ferro-cyanide test, giving as good satisfaction in every respect as either of the former solutions without the bother of testing.

Spraying Machines.—Almost every farm paper that is published today contains advertisements of 10 or more spraying machines. Many of these machines have been tested and are found to do the work required. However, no one machine has yet been built that will satisfy the personal preference of

all growers. There are several requirements that a spraying machine should include to give the highest results.

1. It should have a pump of large enough capacity to maintain a pressure of about 100 pounds.

2. It should have an agitator arranged so that it will keep the mixture in motion at all times.



Growing early Celery under canvas, to obtain the earliest product.
Photo by C. E. Dimon.

3. It should have sensible arrangement of the nozzles, the more modern method being with two nozzles arranged to throw the spray at each side of the row of celery, thereby completely covering all parts of the plant.

4. It should have good nozzles, those that will, under the above pressure, send forth a constant misty spray.

5. It should be of light draft, so that it can be drawn over the land without any great amount of injury to the crop nor too great a burden on the horses.

Some of the most desirable types of machines that will include the above are the 150 or 200 gallon tank, gasolene engine sprayers, especially those that have arrangements for spraying from four to six rows at a time, two nozzles being used to spray each row.

Cost of Spraying.—If the 4-6-50 bordeaux formula is used, the following calculation would be in order:

4 pounds copper sulphate at 5¼ cents a pound	21c
6 pounds lime sulphate at 1 cent a pound	6c
Total cost 50 gallons bordeaux	27c

The cost for 50 gallons of the other formulas is very easily ascertained. The total cost of the materials used an acre for the season will vary with the number of times the plants are sprayed and the amount of material used. Generally speaking, $2 an acre would be a low average, and $5.28 cents would be a high average. However, these

two figures represent the most reasonable figures for the average expenses an acre.

Profits from Spraying.—Many times the question is asked, "Show me the profit from spraying." Perhaps an example drawn from

Heavy roofing paper used for blanching early celery.

actual fields of celery owned by two different parties, with the celery in fields adjoining, will answer this question.

No. 1 sprayed five times during the season 1912. This was the first time No. 1 had ever sprayed, but from his long years of experience in growing celery, the owner had come to the conclusion that it paid and the time had come when spraying was absolutely necessary. His celery, when ready

for storage, was practically disease-free, No. 1 field being rated by all who investigated as the very best celery in that section.

No. 2 did not spray, does not believe in it. Fields at storage time very nearly worthless, owing to blight. More than 90% was not deemed fit by owner to store. That which was stored, if not moved soon, would be spoiled by continued blight development in storage.

Conclusions.—No. 1 was able to sell over 90% of his celery as first class, marketable goods, receiving anywhere from $300 to $500 an acre or more.

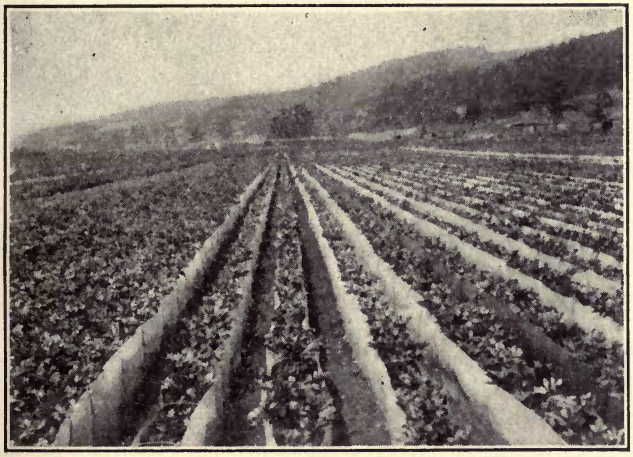
No. 2 was able to sell only 10% of his celery and that of poor to cull grade. On the 10 or more acres, the returns did not pay for the seed.

In conclusion, it is to be emphasized that skilful and effective spraying with considerable attention towards the source of infection, such as removal and destruction of diseased plants, will have a great tendency to materially reduce the cost of protection, while thorough community spraying will tend towards lessened cost for all concerned.

Other Diseases.—Celery has two other diseases: leaf spot, Phyllostictaapii, and rust,

Puccinia bullata. There is a difference to the scientist between all of these diseases. Probably to the average farmer but little difference is noticed. Bordeaux applied often and thoroughly will correct the trouble.

Insects.—Celery on muck lands does not seem to be troubled greatly by insects.



Areandee paper used to blanch early celery.
Photo by C. E. Dimon.

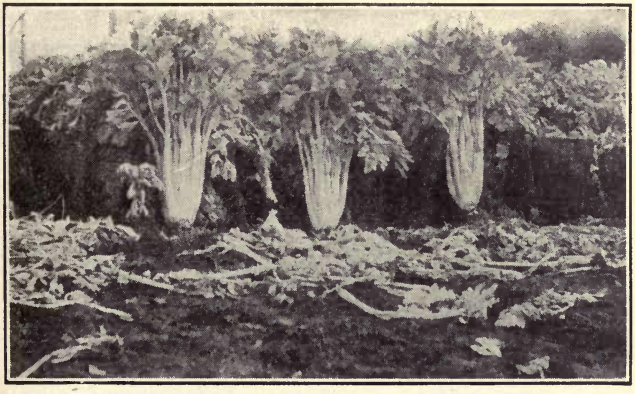
However, the zebra caterpillar and the celery looper are sometimes noticed. These may be easily controlled by hand picking and are sometimes injured by having the vines covered with bordeaux.

Blanching.—Early celery may be blanched in several ways. Three will be given. The most common method seems to be blanching with boards. Boards 12 inches high are generally used. The boards are placed along each side of the row, the outside leaves of the plants being lifted so that they are raised towards the sunlight. The tops of the boards are generally 3 or 4 inches apart, the bottoms of the boards being slightly further separated. The boards are held together with stakes on the outside or with clamps of wire across the top. They may be entirely held by the stakes outside.

If the rows are 18 inches apart, the plants 4 inches apart in the row, it will require 58,000 square feet of lumber to blanch an acre. If the rows are 2 feet apart, plants 4 inches apart in the row, the lumber required is 43,500 square feet; rows 3 feet apart, plants 4 inches apart in the row, lumber required, 29,000; and 4 feet apart, 4 inches apart in the row, 21,750 square feet.

Paper is sometimes substituted for boards. A very good sort of paper is now being made for this particular work. It is somewhat similar to the ordinary roofing paper. The sizes range from 6 inches to 12 inches in

width and 75 to 100 feet in length or even more. The paper is placed one section on each side of the row, the plants being lifted somewhat as the paper is placed near the rows. Every 2 to 3 feet a "U" wire is inserted over the outside of the paper, the ends being thrust into the ground. The paper has given very good satisfaction wherever used.



Sample stalks from Mr. Greffrath's field.

Some farmers are using pieces of red siding paper. This paper is commonly used by carpenters in building houses. In a very few cases, dirt is used for blanching purposes, at first 3 to 6 inches of dirt being thrown up towards the plant, the outside leaves being raised by hand or with a wire attached on

the hiller. More dirt is added in a day or two until the celery has a bank a foot or more in height. One drawback with the dirt blanching seems to be the rust which develops from contact between the plant and the soil. Whatever method is used for blanching, it requires 10 to 20 days and sometimes more before the celery is thoroughly blanched.

Harvesting and crating early celery. To be sold "in the rough."

Harvesting and Marketing.—The boards or paper should be removed when the celery is properly blanched, and a U-shaped steel cutter should be run under the plant, severing the roots, leaving a stub from ½ to 1

inch in length. The celery is then taken from its position, the useless stalks removed from the outside, and the good material immediately placed in crates. If to be marketed in the rough, the celery crates are filled as tightly as possible, from five to nine dozen filling a standard crate, the sides of the crate are nailed on, and the material is placed in the cars and shipped away.

The package known everywhere as the Canastota Basket.

If washed celery is to be sold, the plants are taken to the washing shed, particular attention being given to removing some of the dirt from the outside of the stalk. In some cases, the root stub is trimmed slightly. The celery may then be replaced in the crate and sent to market, or it may be bunched and placed in some other receptacle. At Canastota, N. Y., the well known Canastota basket which is somewhat similar to a market basket, is used for this purpose.

In grading and tying, there are several methods employed. First, in grading, the large sized stalks should be placed together, then the next size, and then a cull lot. If possible, not more than two sizes should be sold. These plants may be tied three together, lying flat, the butts being tied with tape; or 12 plants may be taken and all tied together in a square bundle. Sometimes poor celery is pared down so nothing is left but the hearts. These are then tied in bunches and shipped.

Man power machine for harvesting Celery. A sharp blade of U form noticed between wheels.

The ordinary crate is 24 x 24 inches and holds from 5 to 16 dozen according to the size. Where the celery is shipped in car lots, a car will hold 160 crates. In a great many cases, the celery is sold to the commission men, who come to the muck and buy. In other cases, it is shipped to these men in different cities. In some muck centers it is sold through an association, in others by individuals.

The cost of raising an acre of celery follows:

Rent of land or interest on land	$20 to $60
Plowing, fitting and carting	30 to 50
Commercial fertilizer	35 to 100
Seed and producing plants	10 to 25
Setting plants	15 to 25
Cultivation	15 to 25
Loss on lumber used	10 to 20
Cost of 350 crates and the banking	60 to 100
Total Cost	$195 to 405

The receipts on a large scale vary greatly. Excellent receipts amount to $800 an acre; more common, $500 an acre; in some cases less, even a total loss. The receipts also vary as to the supply and demand. The net profits vary in a like manner, from absolute zero to $500 or more. A grower receiving from $100 to $400 net an acre should feel quite satisfied.

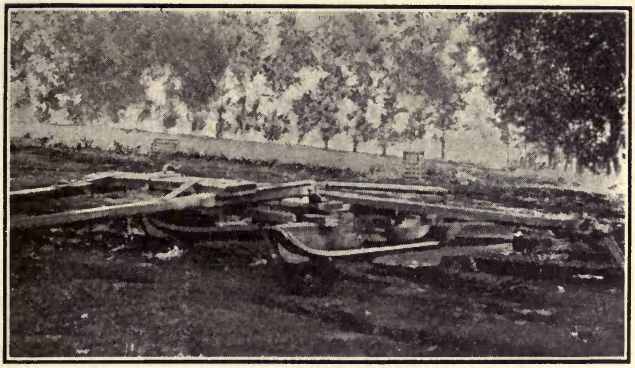
CHAPTER XI

LATE CELERY

Late celery requires the same conditions as to soil that are mentioned for early celery.

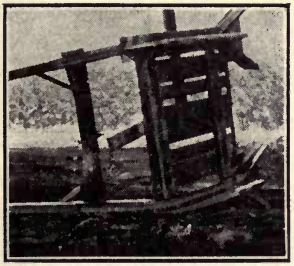
Growing the Plants.—The late celery plants are started generally in a portion of the muck near the field to be planted. A small place at one side is prepared quite thoroughly as early in the spring as possible. Seed is sown in this prepared spot in rows from 6 to 12 inches apart. Very careful attention is given to this bed throughout the early season in order to have a large number of plants for transplanting later. The bed is often sprayed from three to five times with bordeaux mixture.

Transplanting to Field.—The field where celery is to be planted needs to be well plowed; the earlier the better. The plowing is followed by frequent harrowings until the muck is needed for the crop. It should then be thoroughly fitted with tools that fine



Jennings Bros. Marker ready for the horses.

the soil and leave it level. One of the best tools for this thorough fitting is the Acme harrow. Following the harrow it is often advisable to use a planker. This planker will press the soil slightly and leave the surface very level and smooth.



Marker used by Jennings Bros., Canastota, N. Y., to mark rows for Celery, Cabbage, or Cauliflower.

Planting. — Late celery is generally planted in rows 3 feet apart, and the plants are generally from 4 to 6 inches apart in these rows. One of the best methods that

the author has seen for marking out, consists of dragging a sled with two runners across the field, making a furrow from 3 to 4 inches deep in the muck. The plants are then placed in this furrow, the roots having the proper position. The soil is then pressed against the roots. With this method, a man can set a larger number of plants per day than by any other method, six men being able to transplant one acre in a day. The late celery is generally planted from June 15 to July 1.

Fertilizers.—From all indications, a fertilizer containing 4% nitrogen, 8% phosphoric acid, and 10% potash, about 750 pounds to the acre, seems to give the best results, especially so if this amount is supplemented with 150 pounds nitrate of soda two or three times during the season. Some muck growers have found it advisable to use amounts larger than that recommended, even applying as high as 3 tons to the acre. The method of applying this fertilizer to the soil also varies. In some cases it is applied broadcast previous to planting with a broadcasting machine or a fertilizer drill.

In other cases, it is applied with a drill each side of the plants; or from a bucket

held in the crook of the arm, it is applied between the rows. The fertilizer is thoroughly harrowed in and incorporated with the soil. The supplementing of this regular fertilizer with nitrate of soda is carried on in several ways. One good way is to open a small ditch with a man power wheel plow

Hilling celery.

right close to the plants and apply the material by hand in this furrow, covering the fertilizer again with the aid of the plow. Another method is to use a fertilizer distributor, which applies the fertilizer each side of the row. It is then necessary to cultivate the fertilizer into the soil.

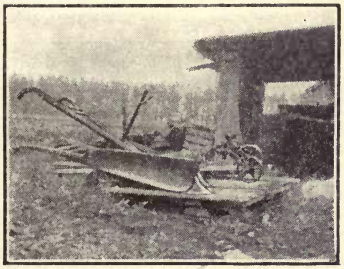
Cultivation.—The plants should be cultivated often, and the work should not be made deep enough to do injury to the roots, as they come very close to the surface of the soil. At least five cultivations during the season are necessary.

Irrigation.—The same system mentioned under early celery may be used with late celery. It is, however, generally considered of less importance with the late than with the early crop.

Spraying.—It is necessary to spray celery from the very first. The celery is troubled by the early blight, Cercospora apii, and the late blight, Septoria pelroselini variety apii. These blights cause discolorations upon the leaves, causing the whole plant to wilt quickly, and thus reduce the crop. They may be somewhat easily controlled if thorough spraying is given. This spraying should be from five to seven times during the season. Celery has two other diseases, leaf spot, Phyllosticta apii, and rust, Puccinia bullata. There is a difference to the scientist between all of these diseases. Probably to the average farmer but little difference is apparent. Bordeaux mixture applied often

and thoroughly, as suggested for the blight, will correct the trouble.

Celery on muck lands does not seem to be troubled greatly by insects. However, the zebra caterpillar and the celery looper are sometimes noticed. These may be easily controlled by hand picking and are sometimes injured by having the vines covered with bordeaux. Bordeaux mixture and how to make it is given under early celery.

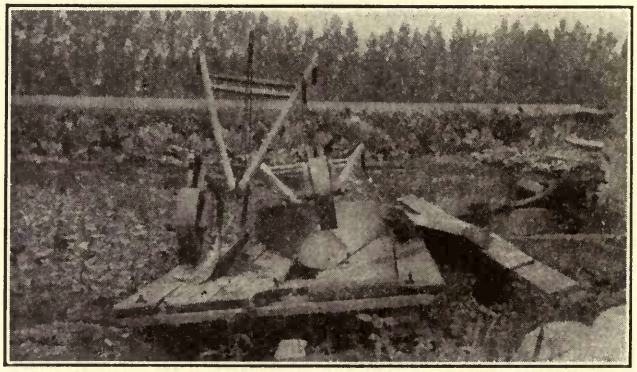


Side view of Celery hillers (one horse type).

Blanching.—The common method of blanching late celery is by the use of soil, at first 3 to 6 inches of soil being thrown up towards the plant, after the outside leaves have been raised by hand or, where the acreage is large, with a wire attachment on the hilling machine. More soil is added in a day or two until the celery has a bank a foot or more in height. In some particular cases, boards 12 inches high are used. This is especially true where the celery is going to

be sold directly from the field or where the planting has been very close.

The boards are placed along each side of the row, the outside leaves of the plants being lifted so that they are raised towards the sunlight. The tops of the boards are generally 3 or 4 inches apart, the bottom of

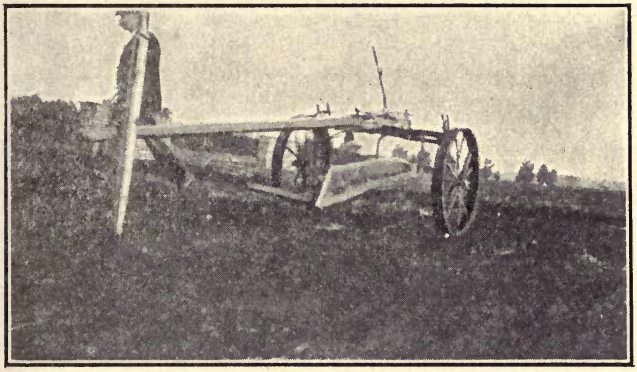


Single and double moldboard celery hillers (one horse type).

the boards being slightly further separated. The boards are held together with stakes on the outside or wire clamps across the top. They may be entirely held by the stakes outside. If the rows are 18 inches apart, the plants 4 inches apart in the row, it will require 65,000 square feet of lumber to blanch an acre; if the rows are 3 feet apart and

plants 4 inches apart in the row, the lumber required is 29,000 square feet; if the rows are 4 feet apart and the plants 4 inches apart in the row, 21,750 square feet are needed.

Paper is sometimes substituted for boards. A very good sort of paper is now being made for this particular work. It is somewhat similar to the ordinary roofing paper. The sizes range from 6 inches to 12 inches in



Two horse celery banker or hiller.

width and 75 feet to 100 feet in length or even more. Paper is placed one section on each side of the row, the plants being lifted somewhat as the paper is placed near the row. Every 2 or 3 feet a U-wire is inserted over the outside of the paper, the ends being thrust into the ground. The paper has given very good satisfaction wherever used.

Harvesting.—If boards or paper are used for blanching, they are removed when the celery is properly blanched. If soil is used, it should be plowed away from each side of the row. Following the removal of the soil or other blanching material, a U-shaped steel cutter should be run under the plants, severing the roots and leaving a stub from ½ to 1 inch in length. The celery is then taken from its position, the useless outside stalks removed, and immediately the good material is placed in crates.

If to be marketed in the rough, the celery crates are filled as tightly as possible at this time, from five to nine dozen filling a standard crate. The sides of the crate are nailed on and all is placed in the cars and shipped away. If washed celery is to be sold, the plants are taken to the washing shed, particular attention given to removing some of the dirt from the outside of the stalks, and in some cases the root is trimmed slightly. The celery may be then replaced in the crates and sent to market, or it may be bunched and placed in some other receptacle.

At Canastota, N. Y., the well known Canastota basket, which is somewhat similar to a market basket, is used for this purpose. In grading and tying, there are several

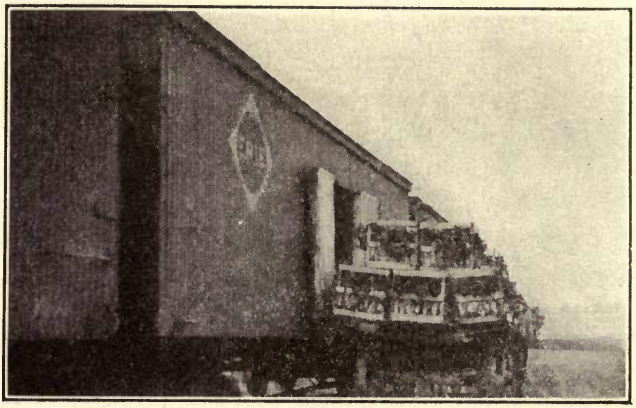
methods employed. First, in grading, the large size stalks should be placed together, then the next size, and then a cull lot. If possible, not more than two sizes should be sold. These plants may be tied three plants together, lying flat, the butts being tied with tape, or 12 plants may be taken and all tied together in a square bundle.

Sometimes poor celery is pared down so nothing is left but the hearts. These are then tied in bunches and shipped. The ordinary crate is 24 x 24 inches and holds from 5 to 16 dozen according to the size. Where the celery is shipped in carlots, a car will hold 160 crates. In a great many cases, the celery is sold to the commission men, who come to the muck and buy. In other cases, it is shipped to these men in different cities. In some muck centers, it is sold

A pile of Celery crates waiting to be filled. Many growers purchase crates, "knocked down," thus saving on the cost. Mr. E. R. Hay, North Rose, has a mill and makes crates for himself and neighbors.

through an association, in others by individuals.

Storing.—If the celery is not to be sold direct from the field, it may be stored. This storage may take place in a commercial storehouse where the celery is to remain in crates or is to be placed in some position,



Loading a car with celery; 160 crates in each car.

generally roots down, in this house; or the celery may be stored in the soil on the field. Where the soil method is practiced, it seems to be wise to at first open a furrow by plowing across the field, then immediately plowing back in this furrow, making the same deeper. Men follow this plowing and even up the sides of the furrow and the bottom.

The plants are then removed after they have been severed by the U-shaped steel cutter, the root stub being placed in the bottom of this trench, generally four to six plants in width being placed at one time. The outside edge is then packed up with muck. Over this muck boards or straw is placed, then more dirt, according to the weather conditions.

The cost of growing celery is itemized as follows:

Plowing, ½ day, one acre	$2.00
Fitting, ¼ day, three to eight times	5.00
Rolling, once or more	1.00
Marking 2 rows at a time, 1 horse, 7 acres a day	.40
Plants, 25 to 50 cents a 1,000, 65,000	21.00
Planting, 6 men, one day	10.00
Fertilizer, 1,000 pounds	18.00
Nitrate	3.00
Cultivation, 20 times	12.50
Spraying, 4 times, material $2, labor $1.50	3.50
Trenching	10.00
Banking	5.00
Putting ears on trenches	2.00
Washing, 2½ to 3½ cents a dozen	90.00
Teaming, 2 days	7.50
300 crates	45.00
Miscellaneous	15.00
Interest on investment, etc.	50.00
	$300.90

3,000 dozen salable, 15 to 50 cents a dozen..$450 to $1,500

A Good Celery Farm.—The A. M. Todd Company, own extensive muck areas in Michigan, the total acreage being 2,100 acres, about 1,000 of which are cleared, drained, and under a high state of cultivation. An extensive system of open ditches has been established the mains being 6 feet across at the top and 4 to 5 feet deep. These divide the

Late celery banked with muck. Notice the long straight rows.

tract into 80-acre pieces, running 160 rods long and 80 rods apart. Lateral ditches 3 feet wide at the top, 1 foot wide at the bottom, and 3 feet deep, were cut every 10 rods, also the long way. All this work was laid out by drainage engineers and it is a pleasure

to see the straight lines of ditches kept scrupulously clean of trash and muck.

The muck varies from 3 to 15 feet deep, and a stratum of grey or white marl runs throughout, in some places coming within 3 feet of the surface. The banks of the ditches stand up well, almost perpendicular, and while the soil is spongy, very little caving is seen along the open ditches.

On this farm 500 acres are planted to mint, 200 to onions, of which 20 acres are for pickling, and 150 acres are in celery. The celery area had been covered with barnyard manure produced on the farm and spread with manure spreaders, of which a number with extra wide tires were in evidence in the implement yards, as also were quite a number of wagons with 8-inch tires. On these wagons the crops are hauled from the fields.

All of the celery is of Golden Self-Blanching variety, set the first half of July, in rows 3½ to 4 feet apart and plants 3 inches apart in the row. This is sold in car lots in late September and quite a lot goes into storage in the larger cities for the Thanksgiving market. The California large square crate, holding about six dozen, is used. The celery is blanched with earth.

The plants for this large area are grown in a four-acre enclosure on slightly raised beds, 5 feet wide and 300 feet long. There are 150 of these beds. A permanent system of overhead irrigation covers the plant yard, and it appears to one that enough plants were grown to plant the entire celery area of Michigan.

CHAPTER XII

CORN

Corn is one of the best crops to use as the first crop to grow on muck land which has just been cleared. Fair yields will be obtained, and by frequently cultivating the crop, the soil is aired and rendered fine.

Sweet Corn.—Sweet corn offers many advantages to a grower who is located near a market or a cannery. Very satisfactory yields of ears will be obtained, as well as a very large amount of fodder.

Varieties.—For early crops, Improved Mammoth Cory and Hiawatha are good. For midseason, Crosby, Quincy Market, Golden Bantam, Carpenter's Improved Golden, and many other sorts will do well. The late crop is mostly made up of Stowell's Evergreen. The last variety needs to be planted early, in order to have it mature before frosts in the fall. Country Gentleman and Zigzag Evergreen are also desirable late sorts.

Seed.—The very best northern grown seed should be purchased, or the grower can select extra early maturing ears of the desired characteristics. Seed, no matter where obtained, needs to be of high quality and well bred.

Extra fancy Celery.

Preparing the Soil.—The muck is leveled and either rolled or planked, in order to firm the soil as much as possible. All coarse wood is removed. The rows may be either marked out one way or cross-marked and planted with a horse or hand machine.

Planting. — One-horse, one-row planters may be used for planting, dropping the seed either in hills or in drills and distributing fertilizer at the same time. Hand planters or the hoe, and dropping the seed by hand may be used. The seed would then be planted in hills. About eight quarts of corn is needed to plant an acre. Distances for early sorts are 20 to 30 inches between hills

and 36 inches between rows; mid-season, 24 to 36 inches between hills and 36 to 42 inches between rows; and late varieties, 30 to 42 inches between hills and 36 to 42 inches between rows.

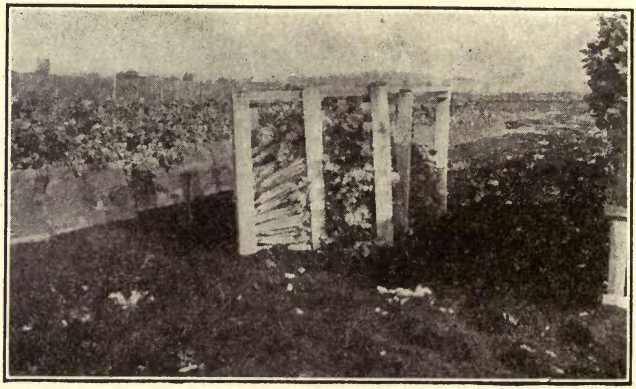
For drill sowing, the distance between rows is the same as above, but the plants are from 9 to 14 inches apart in the row. The seed is planted about 1 inch deep, four to six kernels in a hill. Later thin the hills to three plants. It will be noticed that more space is given to corn grown on muck. This extra space is necessary to accommodate the larger growth of the plant. Do not plant corn until all danger from frost is past. May 15 to 20 is probably the earliest date.

Fertilizer.—About 500 to 750 pounds of a 2% nitrogen, 7% phosphoric acid and 8% potash fertilizer is correct for corn on muck. All of the material may be placed in the row. The fertilizer need to be of a lasting nature, made up with a high grade tankage base and not all minerals.

Cultivation.—The more cultivation given, the better will be the results as to crop and much sooner will the muck be in good condition to grow the more intense crops, such

as celery, onions, or lettuce. No weeds and frequent shallow cultivation is the watchword.

Suckering.—Suckering of sweet corn seems to give results. The process of suckering is to remove the lateral shoots which start from the base of the main stalk near the ground. A quick, sharp pull will break them off. It is generally considered that more ears are obtained where suckering is practiced.



Celery placed in crates direct from field. "In the rough."

Insects and Diseases.—Corn has very few insects that are a serious menace. Cutworms, stalk borers, ear worms or corn boll worms, trouble sometimes in different sec-

tions. There are probably no satisfactory remedies.

The principal disease of corn is the smut. This is a whitish-gray growth, turning to black, found in any part of the corn above ground. Preventative measures, such as cutting out and destroying all diseased parts, are the best remedies.

Harvesting and Marketing.—When the ears have reached their proper stage for market, i.e., when the kernels are in the milk, it is time to break them from the stalk. Care is given not to injure the remaining plant and also to break the ear off with as little butt as possible. The ears may be collected in baskets or boxes and taken to the shed for grading and packing in proper receptacles for marketing, crates, boxes, or bags being used. If the corn goes to the cannery, the ears are placed loose in a wagon box and delivered direct to the platform at the factory. In any event do not bruise the ears, as they lose value if handled roughly.

Yields, Costs, Etc.—A good yield of sweet corn is 1,000 dozen ears, while an average of 600 to 800 would be fair. From two and a half to four, sometimes five, tons of ears are harvested for canning.

Canneries pay from $9 to $12 a ton for corn delivered at the factory. Corn on the general market or at the store brings from 5 to 20 cents a dozen. A common price paid for good corn is 75 cents per 100 ears.

It costs to grow an acre from $25 to $35, sometimes more. Marketing costs vary from $10 to $25 an acre according to where

The truck used to carry vegetables to Buffalo, Niagara Falls and Tonawanda.

and how the corn is sold. Fodder is worth to feed or placed in the silo from $5 to $15 an acre. Large growing sorts will yield heavily if planted for silage use.

The net returns vary as well, often being as low as $10 an acre, sometimes a dead loss; they may be as high as $50 or $60.

Field Corn.—In place of sweet corn, many sorts of field corn can be substituted. The general conditions for sweet corn growing apply equally to field corn. Varieties of field corn that will do well on muck are the flints. Some few dents, as Early Ohio, Early Norther, and Leaming, will give large yields of leaves and stalks. Sometimes 20 tons or more of green forage per acre is obtained. It is generally advisable to grow field corn on muck for silage purposes, thus avoiding loss by early fall frosts.

Field corn grown on muck can be harvested in the same way as when grown on upland soil, either with a corn harvester or by hand.

CHAPTER XIII

LETTUCE

Lettuce requires the very deepest of muck for its most rapid development. If muck is less than 3 feet deep, it is questionable whether good lettuce can be obtained. Muck 3 feet and deeper seems to be about right. At Albion, N. Y., where there is over 100 acres planted to the crop each year, the muck averages about 6 feet or deeper. The reason for this depth of muck is that the lettuce requires coolness about its roots. The muck is preferably derived from the best deciduous trees and not from evergreens or tamaracks.

Varieties.—There is practically but one variety of lettuce to grow on muck: That is Big Boston. This is the sort that is grown everywhere. However, there is a great variation in source of the seed. From tests carried on in different sections of the country and from inquiry among the men growing

lettuce, it is noticeable that a great many people buy their seed direct from certain large seed companies. There are a few other good sorts of lettuce that will produce fine heads and which are worth mentioning. Black Seeded Simpson is one, Deacon another, May King another, and the Cos or Romaine lettuce. The author had under his observation tests of some 35 varieties of lettuce grown on muck, and without exception, each one was at its very best.

Preparing Land.—The land for lettuce is prepared by plowing or harrowing and then smoothing with a fine working harrow. After the fining of the soil, the land is planked or rolled. Planking is preferred, as it leaves the soil in a much better condition and obviates hoof marks of horses. If the job is well done, the surface of the muck is made as smooth and level as a floor and without any ridges.

Fertilizer.—Fertilizer used for this crop generally varies from 1,000 to 1,500 pounds per acre, preferably of the formula, 2% nitrogen, 8% phosphoric acid and 10% potash. The fertilizer is broadcasted at the time of sowing seed and is generally supplemented by one or two applications of nitrate of soda,

150 to 200 pounds an acre according to the indications in the change of the color of the leaves. Sometimes supplementary applications are not necessary. When nitrate of soda is considered unsafe in the growers' hands, it is advisable for them to use fish tankage, about 300 pounds an acre.

Planting.—Lettuce is planted from May 1 to 15, in order to obtain a crop the first of July. It requires from 9 to 11 weeks, sometimes a little more, to mature a crop of lettuce, and the grower must plan to have a crop on time. The seed is generally sown with a one-row seed drill, the rows being 12 inches apart and the seed about a half to three-quarters of an inch below the ground. In some cases, by experienced men, the seed is soaked before sowing. A quantity of seed is placed in a bag and allowed to remain in lukewarm water over night or a little longer.

It is then removed from the bag and mixed thoroughly with very dry, finely screened muck. This very dry muck easily absorbs the water from the seed, and by shaking the seed and muck over a very fine sieve, the muck passes through the mesh, while the seed is retained in practically a dry condition. In that way 10 or 15 minutes after

the seed is taken from the water it is ready to be placed in the machine and sown. By so doing, it is often possible to hasten the crop greatly. Sometimes the seed which is soaked is above ground in two days. This is a decided gain over dry seed sowing.

Sometimes lettuce is planted with the idea of sowing a crop of celery between. Then

Companion Crops: Early Lettuce, Late Celery.

every third row of lettuce is skipped, and only the other rows are planted with the seed. The celery can then be planted in this skipped row.

The grower should plan to plant another strip of land in about 10 days or two weeks after the first planting, and so on until the middle or the last of July, when planting

ceases. In this way, it is possible to have a continuous supply of lettuce throughout the season. In some cases, two crops of lettuce can be grown on the same land in the season, thus doubling the returns.

Cultivation.—The very best of shallow cultivation is given. This cultivation is possible with the shallow-working wheeled hoes or the shuffle hoe. The number of times the crop is cultivated during the season varies from 4 to 15 times. If the crop has been preceded by a crop that is naturally weedy, such as onions, more cultivations will be necessary to keep the weeds down. If the crop has been preceded by a crop of celery and the weeds are not so numerous and rains not too frequent during the season, fewer cultivations will be necessary. One of the best tools for cultivating lettuce when small, is the disc-wheeled harrow, man power. With a good man, it is possible to work all but a half inch of the soil. The half inch would be in the row. By this process, hand weeding is practically done away with.

Irrigation.—Lettuce is also greatly benefited by applications of water during certain periods in its life. Probably the most successful form of irrigation is overhead. This

system consists of a series of pipes installed above the field, one line of pipe being placed every 50 feet. The pipes may be from 100 to 300 feet long or longer. In these pipes are installed nozzles which, under pressure, will cause the water to reach out 35 feet from the pipe line. The pipes are turned by man or automatic power, aided by a specially constructed union. In very dry times, it is an advantage to apply about an inch of water to an acre every 10 days. Very rapid development of the crop results.

Thinning.—If the seed is sown in the rows and comes up rather thickly, it would be necessary to thin the same, in order to obtain heads. There are special tools made for this thinning. However, it can be easily thinned with the hands or with a hoe. At South Lima, N. Y., many of the growers use a triangular-shaped tool with a long handle and thus get away from the back-bending work. At first the lettuce is thinned to stand at least 6 to 7 inches apart and finally from 12 to 14 inches apart in the row. The first thinning would come when the lettuce is probably about an inch to an inch and a quarter tall, and the final thinning when the plants have reached the height of 2 to 2½

inches or a little more. This thinning also aids in working the soil in the row.

Insects.—Practically the only insect that troubles lettuce is the louse. In some of the very dry seasons, the lice predominate and the lettuce is found to go "under." There is no practical remedy for this pest. When it becomes quite common, it is probably best to plow the crop under. However, if the grower wishes to try to save it, commercial nicotine sulphate, diluted as per directions on the package and applied thoroughly to the plant, care being taken to hit the insects with the spray, will have a tendency to kill a large number of the pests.

Diseases.—There are several diseases which trouble lettuce. The damping-off disease is one of the most common. It comes where there is poor sanitary condition of the land, where there is poor drainage and where the plants are allowed to grow too thickly. By correcting these conditions, the damping-off may be remedied somewhat.

Lettuce-drop is another trouble which sometimes comes to this plant. It is generally accompanied by rot, the same as the damping-off. Starting at the stem and working on the underside of the leaf, this rot

begins and soon stops the functions of the leaves, causing them to drop and soon dry up. There is no good remedy for this trouble. The rotation of crops probably is the most feasible.

Downy mildew is sometimes found on lettuce, generally causing a slight discoloration of the leaf, but as a general rule being of very little injury, as it affects mostly the outside leaves. Good sanitary conditions with plenty of light will remedy this difficulty. Leaf spot is sometimes observed on lettuce, but has never been very troublesome. There is no satisfactory remedy.

There seems to be one other trouble with lettuce which has not been classified as a disease nor as an insect injury. It probably would come under the head of physiological trouble, mentioned by the growers as being white heart. The lettuce seems to grow all right until a certain stage is reached. The outside leaves then seem to separate from the heart, and the leaves turn a light yellow color without forming any compact heart. The plant is never fit to sell. The author has noticed patches where this trouble was present to the extent of 50 to 60 per cent. It is generally found on portions of ground

which has been devoted to lettuce growing for a considerable period. The remedy, therefore, may be rotation and a longer time between lettuce crops.

Harvesting and Marketing.—The lettuce is harvested when mature; that is, when the heads have reached a solid condition and are of good size. This condition of the lettuce becomes common to the grower when he has obtained some experience. Generally speaking, the plant is raised slightly and a knife inserted, severing the root. One or two of the outside leaves may be removed, and the lettuce is immediately placed in a hamper or a box without any further trouble.

Where hampers are concerned, generally four heads are placed in the bottom, if smaller heads, then five cover the bottom. The next layer would increase one head, the layer above that one head, and the two layers above that increase two or more heads according to the size. It is highly important that lettuce of uniform size be placed in each hamper. In the case of boxes, where two dozen are placed in a box, the butts of the lettuce are placed out, the lettuce being placed in rows 3 x 4. The heads or top

of the lettuce are then together. Sometimes it is advisable to place a sheet of paper between these rows.

At Canastota, N. Y., where growers are just beginning to grow lettuce, the Canastota celery basket is used. The basket is

A fine "stand" of lettuce.

very good for this work. However, the growers have deemed it best to wash the lettuce, a very uncommon practice on muck. A row of lettuce is placed in the bottom of the basket and another row over this, care being exercised to keep the butts away from the choice top. The reason for keeping the butts out is that the milk or juice from the plant will discolor the leaves if it comes in contact with them. Two dozen heads are

usually placed in a large size Canastota basket.

It may be of interest to some growers of muck vegetables to see the trend of the modern methods in shipping the goods to market. A little article found in the Produce News is given here:

"Some truck growers within 50 miles of New York have made an experiment of moving their quickly perishable stock by automobiles instead of by express. Sam Deutsch, the celery man, who grows celery and lettuce extensively at Chester, N. Y., has put on two automobile trucks which operate a load daily. These trucks gather lettuce and celery as far as Montgomery, N. Y., 75 miles from the produce district. They leave New York City at six in the morning and return seldom later than eight o'clock at night, and the celery and lettuce are delivered early at the docks or to customers who have bought it. The expense of the automobile is a trifle less than the charges of the express company, and the delivery is more certain and more satisfactory.

"The automobiles are rigged with a rack which carries 300 baskets of lettuce or 80 crates of celery. There is now a special

automobile truck under construction for this service, and it will be ready in two weeks. A special rack to be constructed, will probably make a saving over express charges. This experiment, which has been in operation a short time, is likely to lead to further service for trucks in Orange County, N. Y."

Shipping.—Practically all of the lettuce is shipped in refrigerator cars. Lettuce is a very perishable product and must reach the market as soon as possible and must be carried so that it will keep in condition. Lettuce is one crop that is benefited by precooling. If growers are able to harvest the lettuce and place it in cold storage for a short while, the lettuce will carry to market much better and less loss will be found. Most of the lettuce from muck goes direct to commission houses. There are some growers of lettuce on muck soils who have a private trade, shipping from one to 50 hampers a day to this trade. Trade of this sort is found in grocery stores, hotels, dining cars, restaurants, clubs, etc.

As a rule, the price of lettuce varies. However, there is one man in New York, who keeps the price of his lettuce practically constant. This man is catering to private trade.

Cost, Yields and Results.—It costs to grow a crop of lettuce about as follows:

Plowing, ½ day	$2.00 to $2.50
Fitting, 3 to 8 times	5.00 to 7.00
Rolling or planking	1.00 to 2.00
Seed, 5 to 8 pounds	2.50 to 8.00
Planting	2.50 to 3.50
Fertilizer, 1,000 to 1,500 pounds	15.00 to 20.00
Sodium Nitrate, once or twice	3.00 to 5.00
Cultivation, 4 to 15 times	3.00 to 12.00
Harvesting	20.00 to 35.00
Crates or hampers	70.00 to 100.00
Total	$124.00 to $195.00

Lettuce and celery on farm of C. C. Mowris, So. Lima, N. Y.

Where a large acreage of lettuce is grown, it has been found that the cost decreases, and a fair figure for growing a crop of lettuce up to marketing is $80 to $85.

The returns from a crop of lettuce vary from 1,000 to 2,500 dozen heads; the price received again varying from as low as 25 cents to 50 cents a dozen heads or even more. The returns would, therefore, vary as much, as low as $500 to $1,250 an acre. In some cases, the returns are absolute zero, and the grower is out the expense of growing the crop. The net would, therefore, vary as much. Several growers who have been in the business for many years have positively stated that their average returns from the crop are about $500 an acre leaving a total of about $350 an acre net per crop. Where two crops are raised, the figures are about doubled.

One of the best prices for a single crop that the author has observed was obtained from six acres of lettuce in Albion, N. Y. The lettuce was low priced when harvested. The crop was placed in cold storage for three weeks. It was then sold, $4,500 being received for the crop or about $750 an acre. It took this crop 11 weeks to grow and three

weeks in storage. It probably netted the growers something more than $3,500.

CHAPTER XIV

MINT

Very few muck men grow mint. However, one of the largest muck owners, the A. M. Todd Company of Michigan, is recognized as being the largest grower and distiller of peppermint in the world. About 500 acres are devoted to the crop. This large area occupies more muck than any one other single crop. Also more capital is invested in the growing and distilling of the crop than in any other line. Each still cost $5,000 or more, and there are several of them. During the months of August and September, they are running day and night. Its president, A. M. Todd, was kind enough to give the author much detail regarding the growing of this valuable crop.

Preparing and Planting.—"The crop is propagated or started by the use of root-stocks or 'runners,' which are formed each

year during the summer immediately following the planting of the 'new mint.' These runners spread over the surface of the ground and also immediately under it, and vary from 1 to 3 feet or more in length, according to the richness of the ground. They are, of course, grown outdoors with the regular crop of mint.

"For planting, the ground is prepared as for corn or potatoes or most other crops; that is, it is plowed and harrowed so as to make it as mellow as possible. Furrows are then made 2½ or 3 feet apart, into which the runners are strewn so that the ends will touch each other, there thus being one or more runners everywhere in the furrow. Planting is usually done by men who carry a sack of roots strung over their shoulders.

"From this they draw the roots, strew them in the furrow, and cover them with a swinging motion of their feet a half or 1 inch deep, the depth being immaterial except that it should not be more than 2 inches, and 1 inch is better. The runners, if healthy, and if the soil is good, send up a shoot every 2 or 3 inches of their length. These shoots beginning to appear above the ground a couple of weeks after planting and con-

tinuing for a month, according to conditions."

Fertilizer.—"We use both barnyard manure (using all of this that is made on the farms, as well as shipping in considerable from the stockyards at Chicago) and artificial fertilizer. In the latter, muriate of potash is the chief constituent, but we also use some bone meal or dissolved bone, some superphosphate, and some nitrogen, part in the form of dried blood and part in the form of nitrate of soda."

A large field of Onions.

Cultivation.—"The crop is hoed and weeded by hand and cultivated with horses as potatoes, corn, etc., but of course it is cultivated in only one direction, lengthwise of the row. No spraying is done, for although mint is sometimes attacked with parasites and 'rust,' we know of no spraying that

would kill the parasites without injuring the plant to such an extent that it would be useless for the purpose for which it was raised, which is its essential oil."

Harvesting and Distilling.—"Distilling is accomplished usually in August and September, when the plants are just in bloom, or as nearly as possible. The 'old' mint (which is the crop that has come up spontaneously from the planting of preceding years) matures earliest, sometimes in July, but generally not until the first half of August. It is distilled at that time. The cutting is done the first year by hand. The mint is allowed to dry fairly well in the swath, but it is raked up before it becomes so dry that the leaves will break off. The 'new' mint matures a couple of weeks later and is distilled after the old has been cared for. It is then raked into bunches, where it may lie for a day or two, if the weather is good, before distilling, since the oil is all contained in the leaves and in the blossom. As soon as dried, the bunches are drawn to the distilleries and distilled."

Yields, etc.—"The yield per acre usually varies from one to three tons, depending upon the growth and the thoroughness with

which it is dried. The average yield of oil for a term of years will not vary largely, I think, from five pounds per ton of plants."

CHAPTER XV

ONIONS

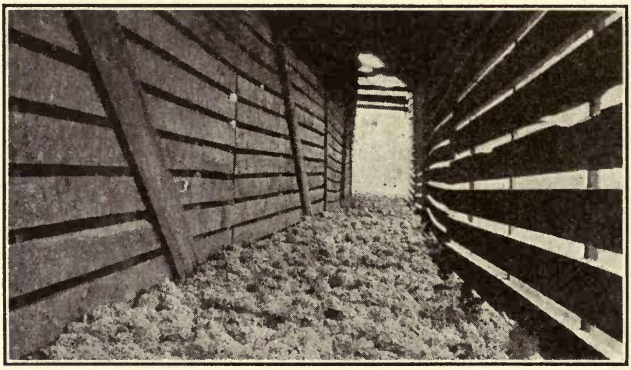
Growing onion seed on farm of C. C. Mowris, So. Lima, N. Y.

First class muck for onions is darkish brown in color. If too light a color, it does not seem to give as good results as if a

darker nature. This muck is preferably friable and not too full of coarse pieces of wood. It seems to be an advantage to have the soil neutral. Therefore, if the soil responds to an acid test, it might be necessary to apply lime, using from one to two tons an acre. The muck soil needs to be at least 12 to 18 inches deep for the best growth. Where the soil is shallow, oftentimes the plants suffer during a drouth. The water table should be about 3 feet below the surface. If shallower, the water often covers the onions, especially during rainy periods, causing the roots to drown out. If the water table is deeper, sometimes deficiency during drouthy periods results.

Varieties.—Probably but two varieties of onions for muck purposes are grown very extensively. They are the Yellow Globe Danvers and the Southport Yellow Globe. At times, in a limited way, the Southport Red Globe and the Red Wethersfield are grown. However, the market is very limited for these red sorts. Certain men have practiced the growing of this seed in a very thorough manner. It seems to be a desirable idea to buy seed from these men. In tests which have been made with onions, it

has been found that where a grower has exercised considerable care in the selection of the onions from the field, storing them carefully through the winter and growing them properly the next year, that there is an increased return from the onions grown from this seed.



Onion seed balls drying in Onion crib at Jennings Bros., Canastota, N. Y.

Preparation of Land.—The land for onions may be prepared in one or two ways. It may be plowed from 4 to 7 inches. If it is quite new muck, it would probably be better not to plow very deep. If past plowing has been shallow, but little is added each year until a depth of 6 or 7 inches is obtained. If a crop of celery preceded a crop of onions,

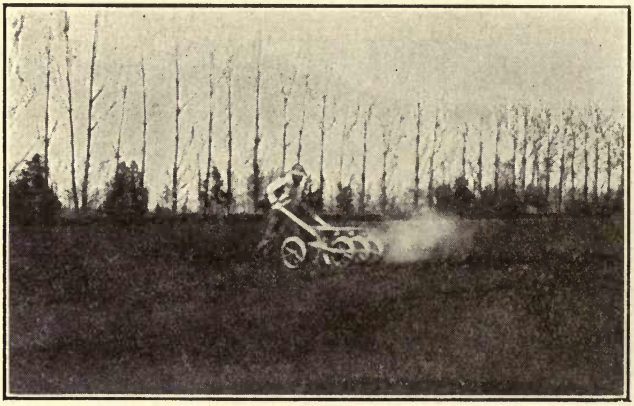
harrowing would be all that is necessary. With this harrowing, leveling of the land would be essential as well.

A rotation where onions follow celery is very good indeed. In this way, the onion crop is practically free of weeds, owing to the fact that celery preceding a crop of onions can be maintained weed-free. Following the plowing, the harrow would be necessary to fine the soil somewhat. The next step in the operation would be with the planker, used in such a way that the land is left both level and somewhat pressed down. If correctly used, the soil is in very fine condition for seed sowing.

Planting.—The amount of seed necessary to plant an acre varies somewhat. However, about six pounds seems to be the amount necessary. This amount will seem somewhat large to most growers of onions, but the crop on the muck soil varies considerably from the upland crop in the fact that the onions in the row are sometimes 2 to 5 wide, and these onions are not thinned.

The seed may be distributed by various types of machines. One-row seeding machines are often used. With these machines, the rows are opened, the seed

dropped and covered, and the soil rolled slightly against the seed, the next row being marked at the same time. If the driving wheel of these particular machines is of large size, the work will be easier and the rows straighter.



Hoffman Planter.
Planting three rows of onions at same time sowing sulphur and lime.

There is a firm in the Middle West which is manufacturing a six-row planter drawn by horse power, planting six rows of onions at one time. Six of these one-row machines are united to work at one time. Another type of machine sows three rows of onions and at the same time applies lime and sul-

phur, a remedy for onion smut. One drawback to the latter machine is the fact that the soil is not pressed tightly against the seed, and subsequent rolling is necessary.

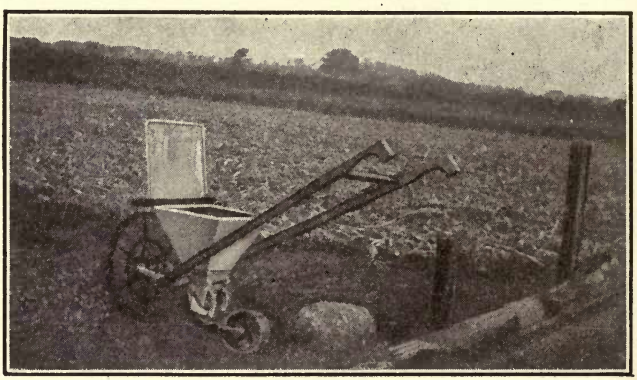
It is absolutely important that the rows be straight and of equal distance apart. The

Rear view of Hoffman Planter.

seed is sown at the depth of a-half to three-quarters inch. Deeper seeding may be necessary at times, especially when the soil is dry. For average conditions, a half inch is sufficient. The distance between rows on an average is 14 inches.

Fertilizer.—Fertilizer varies with many individuals. However, the average composition of fertilizer used for onions is of the

formula, 2% nitrogen, 8% phosphoric acid and 10% potash. If more nitrogen is added to this particular soil, trouble might result, giving a quantity of scallions. The amount of fertilizers to use varies; 1,000 to 1,500 pounds being the most common amount used. However, a ton to the acre is often used on this crop. The method of distribu-



Planter arranged to sow sulphur and lime as well as onion seed.

ting the fertilizer varies. Some growers distribute their fertilizer previous to sowing the seed. In some sections where this has been carried on, later winds have come and blown the fertilizer with the soil and even the seed from the land, giving the grower a total loss for both fertilizer and seed.

One of the best practices now in force in certain sections is to sow the fertilizer broadcast after the plants have grown to some size, probably 3 inches in height. At that time the fertilizer is broadcasted by a machine or by hand. Where a drill fertilizer distributor is used, it would be necessary to apply the fertilizer previous to the planting of the seed, even previous to planking.

Cultivation.—Cultivation begins as soon as possible; that means before the plants have broken through the ground. By the use of a shove hoe or anyone of the wheeled hoes, set so the wheels can work very close to the plants in the row, the desired results will be attained. As the onions permit of culture only early in the season, it is necessary to do this work very thoroughly and very often.

Weeding.—Weeding can be accomplished in two ways. The older practice is by hiring Italian boys and women and sending them through the patch on their hands and knees, extracting the weeds with the fingers. This is an expensive operation and calls for much labor where large acreages are grown. There have been one or two machines developed which are slowly doing away with this

laborious task. The author saw the work of one of these machines in various patches and is justified in saying that, by using them quite frequently, the growers are able to save two finger weedings, it being necessary only to go through the patch once and remove but a few small weeds. Most of the weeds removed by hand were of the large type.

Weeding onions, mostly work of women, girls or boys.

During the summer the onions will continue to grow to large size. In the early fall the tops will begin to lop over and the onions are said to be maturing.

Pulling.—When the major part of the stand has toppled over and is somewhat matured, it is necessary to go through the

crop and pull the onions from the soil, laying the onions in rows. The onions are then placed in a position where the tops will have an opportunity to dry and the necks to grow small and the onions become fully mature. They are said, in this condition to be drying.

Onions after being "pulled" waiting to be dried and topped. The onions will be topped with sheep shears as they lay.

Topping.—If the onions are to be topped by hand, it would be necessary, if the sheep shears were to be used, to lay the onions so that the butts were together and the tops out. That is, if four rows of onions were to be pulled, two rows would be pulled from one side and the tops laid towards the left, and two rows would be pulled on the other side and the tops laid toward the right. The

topper with the sheep shears would pass up one side of this row and sever the tops from the bulbs after the tops have become somewhat dried out, returning and performing the same operation on the other side of the row. Another method of topping is to take each bulb in the hand, and by the use of a knife, sever the top from the bulb.

Topping onions by hand.

Still another method is to shovel the onions from the ground into crates. Take these crates to a large topping machine and pass them through this machine. If the tops are in proper condition, that is, quite thoroughly dried out, the machine will re-

move them very quickly. From the author's observations, as far as the expense is concerned, there is very little difference in expense between these three methods. It costs about 2 cents a bushel in all three cases to top the onions. If plenty of labor is available, the hand method is quite advisable, as conscientious sorting can be given.

Stacking.—As soon as the onions are topped, they are placed in crates and these crates stacked in piles. Five crates are placed on boards at the base, giving space between each crate, four crates above these five, and three above those and sometimes two above that row. Other size stacks can be made if desired. It is important to remember that certain space must be given between the crates in the stack. The onions will cure in the course of a few days in these stacks.

Screening.—From the stacks, the onions are run over a screen. In this way the small onions and all of the bottle or scallion onions need to be taken out, only the first class onions being allowed to fall into one of the crates. Following screening, the onions are ready to be marketed.

Marketing.—Where labor and capital come together on a common basis and work the crop on shares, the onions may be marketed right from the field, the owner taking the first stack of onions and the laborer the next stack, and so on, dividing equally. Generally speaking, the first price for the

A field of onions after topping and crating ready for stacking. Yield 824 bushels from a short two acres. Poor to fair yield.

onions is relatively low, and oftentimes by holding the onions for a short while, a higher price is obtained. In some sections it would be greatly to the advantage of the operators if they would mass their crop and obtain a good salesman to handle the selling proposi-

tion. Then buyers would not be able to dictate what price they would pay for this particular crop, and higher returns would be possible.

Storage.—The onions may be stored temporarily in slat houses. A good sort of an onion bin for storage consists of a house constructed similar to a corn crib, differing slightly in having a floor with openings, as well as the sides. Generally speaking, these houses should not be very wide, nor should the onions be stored very deeply in these houses. It is greatly to the advantage of some growers if they have a storage house, owing to the fact that it helps them in regard to the number of crates which they have to use on their acreage. A certain field could be harvested and the crates emptied into the storage crib, then these same crates used on another field, and so on.

It is generally the best policy not to keep the onions in the crib too long, but to sell them before severe cold weather comes on. Onions may be stored in a refrigerator plant for a longer period. Here detailed attention is given, of necessity, to temperature, and some years higher returns are obtainable.

Costs.—Where tenant farming has been used, the following costs are given. The land owner supplies the plowing, $4.50; harrowing and fitting, $2.50; half the seed, $3.75; half the fertilizer, 800 pounds, $12.00; and use of the crates, $10.00. The tenant supplies half of the above seed and fertilizer and the labor of planting $1.75; labor of weeding, from $25.00 to $30.00; cultivating, from $15.00 to $25.00; pulling $2.50 to $3.00; and topping and placing in crates, varying according to the yield, from $15.00 to $20.00. The crop is divided in the field, half the onions going to the owner and half to the tenant.

A full crate of Onions. Onions very large. This crate was filled in less than five minutes by a eleven year old Italian boy, taking the Onions from the ground one by one and topping before placing in crate.

Some interesting figures have been gathered from actual experience on a piece of land representing 1 1-3 acres.

Plowing, 13 hours	$5.85
(Average date of plowing, April 24)	
Fitting	2.50
Fertilizer, one ton	27.00
Distributing fertilizer	1.75
Seed	7.60
Sowing the seed	1.75
Weeding	38.00
Cultivating	22.00
Pulling	3.10
Raking	1.75
Gathering and topping	19.00
Drawing to the train	20.50
Total	$150.80
Total cost for one acre	$113.10

Stacks of ten crates of onions curing in the field, ready for division between landowner and tenant. One stack to landowner, next to tenant, next to landowner, etc.

According to W. W. Ware, a successful vegetable grower of New York State, who, with W. L. Bonney, are cultivating a large acreage of muck to celery, lettuce and onions, the cost of growing a crop of onions on muck land does not vary a great deal from that of celery. Mr. Ware estimates the cost per acre about as follows, taking no account of overhead charges, such as interest on capital invested, taxes, and depreciation:

Plowing and fitting soil	6.50
Fertilizer	38.00
Sowing fertilizer	1.00
Seed, six pounds at $1.50	9.00
Sowing seed	2.00
Hoeing, eight times	16.00
Hand weeding	40.00
Sorting and drawing to crib and car	30.00
Total	$142.50

Yields.—The yields vary from very low—sometimes absolutely nothing—to as high as 1,000 or 1,200 bushels an acre. A good average crop is 500 or 600 bushels. The prices received vary, as do the returns. In 1912 the prices in the fall was 24 to 30 cents a bushel. It varied from that down to absolute zero. In 1913 the prices varied from 62½ cents to $1.00 in the early part of the season, following, for the storage crop,

with prices as high as $1.62½. The average price for onions is about 45 cents a bushel year in and year out. The gross returns for a crop of 500 bushels at 45 cents a bushel would be $225.00. This amount, of course, would vary with the different factors.

Returns from one field in 1913 showed 667 bushels at an average price of 75 cents a bushel of 57 pounds, making a total gross return of $500.25. The total cost of raising these onions was $150.06, the net being $350.19.

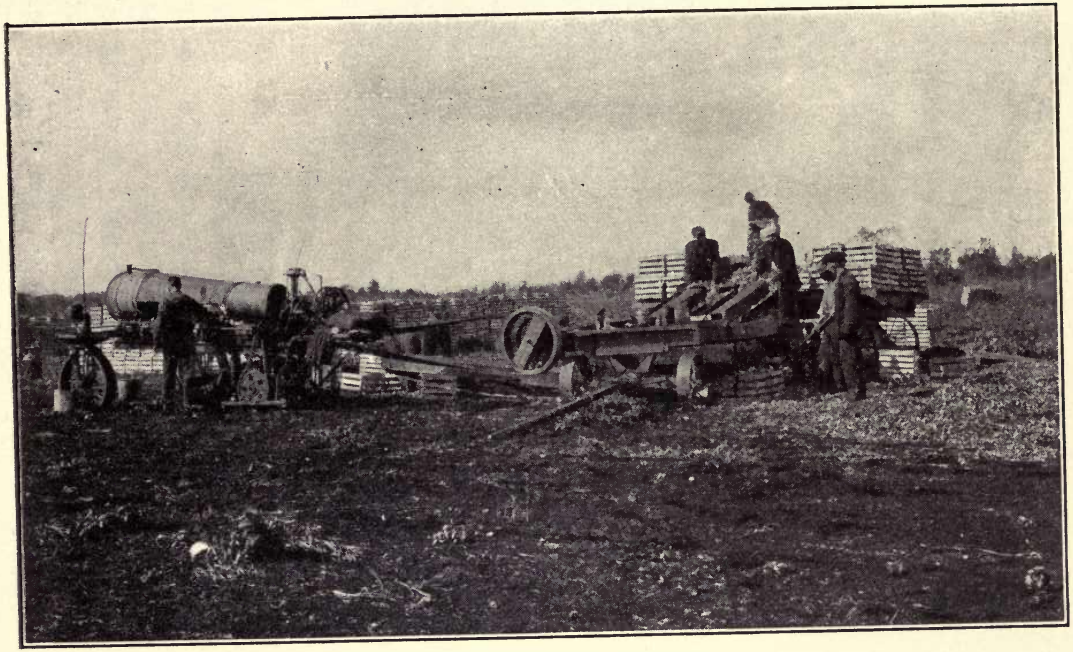
Screening Onions, at the same time picking out the Scullions.

Insects.—The onion maggot is probably the most important insect which bothers. It is an insect which spend its injurious life below the surface of the ground; it is very difficult to combat. The older remedies suggested are rotation of crops, planting the onion as far from the previous year's crop as possible. Another

remedy is cleaning up the old beds, allowing no refuse matter to remain near the beds. Fall plowing is still another remedy. The use of kainit is being recommended quite highly. It seems that the salt in the kainit has a bad effect on the fly or the immature insect.

The latest remedy for the onion maggot is a spray consisting of a fifth ounce of white arsenic, one pint of cheap molasses and one gallon of water, mixed together. This material is sprayed on the foliage of the onions or other plants, beginning at the time when the onions are just breaking through the ground, and continuing for at least six or eight weeks. The spraying must be repeated after each rain. The best practice seems to be that of spraying every fifth day. The molasses attracts the fly, which lays the egg that creates the maggot. The poison will kill the flies when they consume the molasses.

The application of the spray differs from all other sprays; the spray must be in the form of drops and not in a mist, therefore, a watering-pot, whisk brook or some other coarse working material will be necessary to use as an apparatus.



A Vrooman Onion topper driven by a Bates Steel Mule topping from 1,500 to 1,800 bushels a day on muck of Western New York Farms Co., Elba, N. Y.

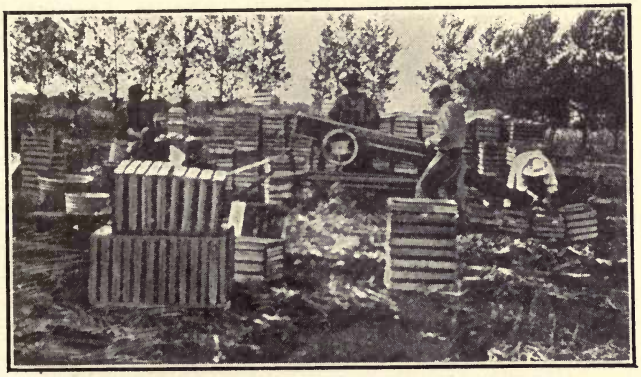
Another insect which troubles the onions is the small thrip. This insect spends most of its life on the leaves and near the surface of the ground. It will often destroy the surface tissue of the leaf, so that it will wilt. The remedy is whale oil soap, one pound to two gallons of water, sprayed on the plants. A tobacco extract, nicotine sulphate, directions given on the can is also a remedy.

Diseases.—Mildew, blight and mold are diseases very abundant about June 15. The remedy is to destroy the tops of the diseased plants. Do not allow them to remain on the patch. Systematic spraying with bordeaux mixture is also a good preventive. Begin when the onions are small and continue during the season. One grower has devised a scheme whereby he can spray onion rows covering 50 feet at one time.

Smut is a disease that is becoming more common each year, causing large loss with this particular crop. The disease infects the soil. Therefore, a treatment of the seed would be of questionable value. One of the older remedies is the use of sulphur and lime, 100 pounds sulphur (powdered or flowers of sulphur) and 50 pounds of fine stone-lime.

Apply in furrow with onion seed at time of planting.

A New Remedy for Onion Smut is the use of one pint of formalin and 16 gallons of water, applied to the onion seed when the seed is sown with the seed drill, using the mixture at the rate of 200 gallons per acre. The best arrangement for applying seems to



Small onion topper and screen.

be that of constructing a small reservoir just above and in the rear of the seed box of the planter, arranging a tube from the base of this reservoir and extending to the rear of the plow opening the furrow. As the seed drops back of the plow, a certain definite amount of the material is applied per

acre. The grower must regulate the flow of the material.

TYPICAL ONION FARM

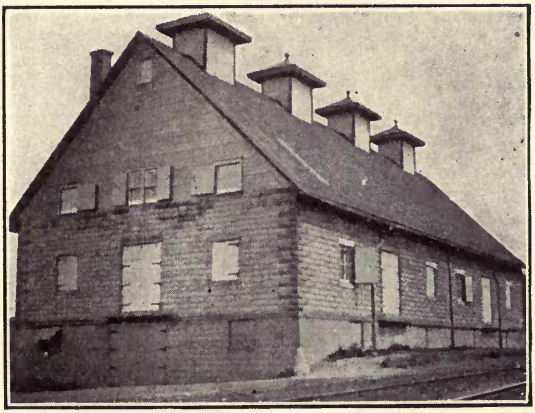
Of the two hundred acres of onions grown on the A. M. Todd Company farms, the following is a short sketch:

"The onions are drilled in rows about 12 inches apart at the rate of about 3½ to 4 pounds per acre. Fifteen drills are operated simultaneously. Nearly 100 acres had to be reseeded one May, as strong winds blew the young plants out of the loose soil soon after they were up.

"One of the interesting scenes on this farm is the weeding of the onions, with over 50 men at work on their knees cleaning onions. The weeds were piled in every fourth space between rows and later carried out to the ditch banks. If left in the field, they would in a few days start new growth on the moist soil. This soil is very moist, clear to the surface. However, the water level is at least 24 to 36 inches below it. The rows are 160 rods or a half mile long.

"For the onions muriate of potash, bought in very large quantities, and 14% acid phos-

phate are used, 1-6-10 being about the proportion of nitrogen, phosphoric acid, and potash. This is used at the rate of 500 pounds per acre. Two onion storehouses are used. These are built with concrete foundation, having a capacity of 80 to 100 cars of onions. The dimensions are about 30 x 150 feet and 30 x 100 feet, with a large annex to one.



Onion Storehouse
50,000 bushels stored here Fall 1913
C. C. Mowris, So. Lima, N. Y.

"Toppers that also grade the onions are used in the fields, with improvements. The onions are packed in slatted crates, holding about one bushel each, and are stored in these crates in the houses."

CHAPTER XVI

PEAS

The requirements of peas are well satisfied in muck soils, that is, a cool, moist soil which is loose and friable. However, the seeming abundance of nitrogen in the soil often results in an excessive vine growth and a deficiency in pod production. Peas are very useful as a first crop, as they mature early and are out of the way for the planting of celery or some other crop.

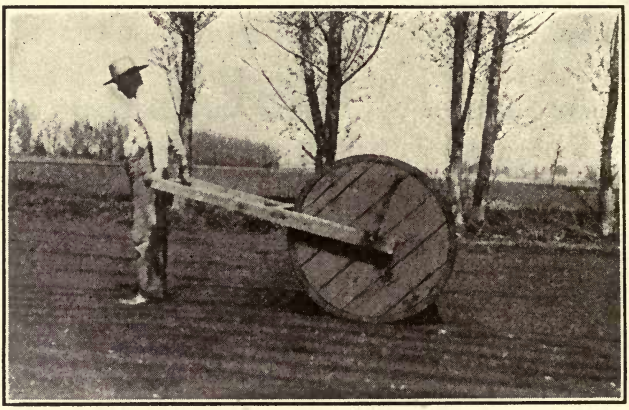
Varieties.—A few varieties which have been tested and found to give satisfaction are the Alaska, a smooth pea producing vines from 20 to 30 inches tall; the Excelsior, a semi-wrinkled pea, the vines of which are from 14 to 18 inches tall; and the Thomas Laxton, a wrinkled pea of the highest quality, the pods being larger than either of the former. The vines grow to the height of about 3 feet. These three have been grown extensively enough to warrant their adop-

tion by any grower. Two late wrinkled sorts that produce very large pods have been grown to some extent: the Duke of Albany and the Dwarf Telephone or Carter's Daisy.

Fertilizer.—As peas are quite liable to run to vine where nitrogen is oversupplied, it is generally not advisable to use fertilizer containing this element. A good fertilizer to use contains 7 to 8% of phosphoric acid and 8 to 10% of potash, about 250 to 500 pounds being broadcasted per acre previous to the planting of the crop. The amount to use will vary with the fertilizing of the previous crop. Phosphorus is very important.

Preparing and Planting.—The muck is plowed or harrowed and planked, as previously mentioned. If to be grown without cultivation, a grain drill may be used for sowing the seed. Use about four bushels of seed per acre, sowing half east and west and the other half north and south, and allowing the seed to run out of each tube. If cultivation is to be given the rows will have to be farther apart, 18 to 24 inches for the Alaska or Excelsior and 24 to 36 inches for the others. The seed is planted about 2 inches deep. Immediately after planting, a

roller is used to compact the soil against the seed.



A good man power roller firming muck after planting the seed.

Cultivation.—Where the pea crop is grown for canning purposes, no cultivation is given. Therefore, the preparation of the land must be very thorough. In the commercial garden, cultivation is given early and often. Some men think it advisable to pass through the crop at least every five days. This would be a good practice for the small gardener. In the case of the pea crop, 477 pounds of water are needed to produce one pound of dry matter. It is, therefore, very evident that cultivation is neces-

sary to conserve this moisture in the soil. Shallow culture is always advisable. The roots of the plant come so near the surface of the soil and spread so far that deep cultivation will be the cause of great injury.

Harvesting (Canning).—As soon as the pods are ready and the inspector has given the word, the vines are harvested. These may be cut with a scythe if a grower does not have the more modern machinery, or a mowing machine may be used. Where the latter is used, an ordinary hand rake may serve to collect in bunches, and men with forks may follow and place them in a furrow. From this furrow, they are placed in the wagon. If the peas are to be raised in the most modern way for canning purposes, they are harvested with a pea swather.

This is a special machine having long fingered guards to lift the vines. These guards are placed on the cutter bar of a specially constructed mowing machine. The knives of this machine cut the vines, and if a platform is constructed in the rear of this cutter bar, an arrangement of circulating arms, the peas will be left in a swath following the machine. Ten acres per day under favorable conditions can be harvested by this

method. Where the platform is not used back of the bar, a side delivery rake is often employed. The rake will place the vines in a swath. Following the side delivery rake, hay loaders are used which place the vines immediately upon the wagon. They are then carried to the canner. Where a hay loader is not used, the pea vines are thrown in the wagon by hand, similarly to loading hay.

A load of onion crates ready to go out on the field.

Commercial.—The peas are separated from the vine by hand and the pods collected in hampers or baskets. The average price for picking a bushel of peas varies according to the labor supply and the heaviness of the yield—from 15 to 25 cents a bushel. It would be a good practice for the harvesters

to grade the peas as they are picked into at least two grades, the first being the highest quality and the others the culls. The baskets containing the peas are sealed at once and shipped immediately. Precooling is desirable. If this crop is slightly moist when harvested, cars will heat and often arrive at destination in poor condition.

Yields.—From 1,500 to 2,500 pounds of shelled peas per acre are often obtained, especially where some attention is given to the methods as described above. As much as two tons have been obtained in very favorable conditions. The commercial gardener averages about 75 to 150 bushels an acre, according to the method of planting and the variety. In the small garden, a row about 100 feet long would give three to five bushels. Of course, this will vary with the variety and other conditions.

Canneries pay from 2 to 2½ cents a pound for shelled peas. Lately there has been a system introduced into some canneries where no hard peas or extremely large sorts are paid as high as 3 cents a pound. From this, peas grade down to as low as 1½ cents a pound for peas containing hard seeds and varying sizes. In the commercial garden

$3.00 or a little more is sometimes received per bushel, and this price soon drops to as low as 50 cents a bushel or less. The earlier and larger the peas, the higher the price.

As a general rule, the cost of producing an acre of canning peas varies from $30.00 to $45.00. That includes all the work connected with the crop. In the commercial garden the cost varies from $40.00 to $75.00, according to the method of planting and the yield. The profits from a canning crop are generally very limited. In many locations in New York State, there is a dead loss instead of profit. If a man is able to obtain profit of $15.00 to $25.00 an acre, he should be satisfied. In the commercial garden, at times from $75.00 to $100.00 profit is received. A man receiving $50 to $75 for this crop and following with another vegetable crop in the same season should be satisfied.

Insects.—Pea Weevil is one of the common insects. This is a beetle of brownish-gray color, having two black dots near the anal part of the body. Its head is bent under the body and ends in a sharp snout. This insect is quite common when the peas are in bloom. It deposits an egg on the young pod. The grub enters and eats its

way into the interior of the pod, entering the pea. The insect remains within the seed throughout this larval stage and also through the pupal stage or rest stage, coming out in the early spring after the seed has been planted as a beetle to lay more eggs. The remedy in controlling the insect is to

Companion Crops.
Two rows of onions each side of a row of late celery.

use bisulphide of carbon to fumigate the seeds. The way to do this is to place 100 pounds of seeds in a tight barrel or bin. Use an ounce of bisulphide of carbon, pouring it over the seeds, and close the receptacle tightly. Allow this to remain for some time. The beetle will then be destroyed.

Pea Louse. The annual loss from this insect runs into many millions of dollars. It is a small greenish-black insect with long legs, found on the underside of the leaves. It is very tender and, therefore, can be easily controlled. On a small scale, nicotine sulphate can be sprayed on the plants. A solution of kerosene and water, 25% kerosene may be used. Many birds and insects are its natural enemies. In the season of 1912, the author saw the work of the swallows and the martins, which destroyed millions of these insects on his patch of peas. Another method is to cultivate the peas, sending a boy ahead to knock the pests from the vines, then bury these insects with the cultivator.

Diseases.—Blight or Leaf Spot. This is a discolored area generally found upon the stem near the ground. It is somewhat similar to anthracnose on the bean. The disease works through the pod and to the seed, infecting it. The remedy is self-evident. Select seed that is not infected. The vines may be sprayed with bordeaux, beginning when 4 to 6 inches in height and continuing about every four to six days. After the crop has been harvested, the vines are

burned in order to check the spread of the disease.

Mildew. This is a whitish or graying coating found on the leaves generally late in the season and after the weather has become somewhat warm. The remedy is bordeaux mixture sprayed several times.

CHAPTER XVII

POTATOES

Potato growing in muck soil generally results in large yields, probably because the potato finds in this soil an abundant and a constant supply of moisture, and partly because of the loose, friable soil conditions which offer but little resistance to large tuber formation. Potatoes are particularly good for a first or second crop on new muck.

Varieties.—Some people do not care for potatoes grown on muck, giving as a reason that the potatoes are soggy. Probably the reason for this sogginess is found in the fact that not all potatoes are particularly adapted to this class of soils. Irish Cobbler, Green Mountain, Mills' Prize, and several other of the larger white-skinned types have not given satisfaction.

Most of the red or pink-skinned potatoes do well. Early Rose and Early Norther have given excellent results. A grower in

New York State has tested out several sorts and has found that Early Everett is the best on his muck. More attention should be given to the adaptation of varieties to the soil. Many more good sorts of potatoes would be found if adequate tests were carried out.

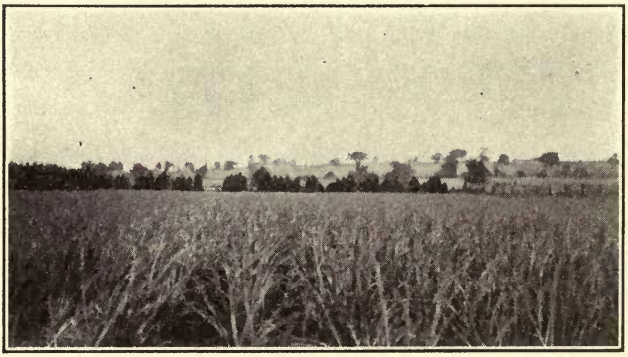
Seed.—Only the very best selected seed should be used. Seed selected in the field as dug is preferable to bin choice. Field-selected means plant-selected. The grower is then sure that the potatoes to be planted came from a plant that produced five or more average sized, marketable tubers. Do not plant the extra large nor the small tubers. From 12 to 15 bushels of seed potatoes will be needed to plant each acre.

The seed potatoes are cut in such a manner that each section of the tuber has two strong eyes and sufficient flesh to give the sprouts a strong, sturdy growth. Most good seed potatoes will give at least four seed pieces.

Preparing for Planting.—The muck is always plowed for potatoes, preferably as deep as 7 inches. Do not plow up too much new material. Harrow the soil until fine and roll, or better, plank it level and smooth.

All of the preparation is done as early in the spring as possible.

Planting.—Do not plant the tubers until about the first of May. In some sections where frosts do not occur on an average later than April 20 to 25, potatoes may be planted a little earlier.



Near view of a fine thick, stand of onions.

If a planter is available, it can be used to plant the potatoes. If not, a plow can be utilized to open the furrow, and the seed can be dropped by hand. Rows from 30 to 36 inches apart and pieces of the tuber every 12 to 15 inches in the row, about 4 inches deep is good practice. After planting, roll the land in order to compact the soil against the seed pieces.

Fertilizers.—From 1,000 to 1,500 pounds of a complete fertilizer is preferably used with the crop. About 2 or 3% nitrogen, 6 to 8% phosphoric acid and 10 to 12% potash in sulphate form will give good results. From 500 to 700 pounds can be applied in the drill, and the remainder broadcasted. Where new muck is being developed and potatoes are to be planted as a first crop, very little if any nitrogen will be found necessary. About 8% phosphoric acid and 10% potash at the rate of 800 to 1,000 pounds an acre will often give the best returns on new land.

The fertilizers now most generally used are the ready mixed sort, costing from $35.00 to $45.00 a ton. In some cases, the chemicals are bought seperately and mixed at the farm, thus saving from $5.00 to $10.00 by this operation. The use of stable manure directly for the potato crop is not now generally practiced. If it is desired to use a home-mixed fertilizer, one of the following mixtures will furnish the plant food required.

Formula:

Nitrate of soda	200 pounds
High grade tankage	600 "
Acid phosphate	800 "
Sulphate of potash	400 "

Another good formula follows:

Nitrate of soda	125 pounds
Sulphate of ammonia	100 "
High grade tankage	250 "
Acid phosphate	725 "
High grade sulphate of potash	300 "
Filler	500 "

The total cost of these fertilizers home-mixed should be between $25.00 and $28.00. The amount of fertilizer to use on any given area would vary with the previous cropping system. On some portions of land, about 1,000 to 1,200 pounds are needed, and where the land is poorer, from 1,500 pounds to a ton is necessary per acre. In the average practice, about 1,200 to 1,500 pounds is sufficient. A good way to use the fertilizer is to distribute it along the open furrows, being careful to scatter it not only in the bottom but well up and even on top of the shoulder of the furrow.

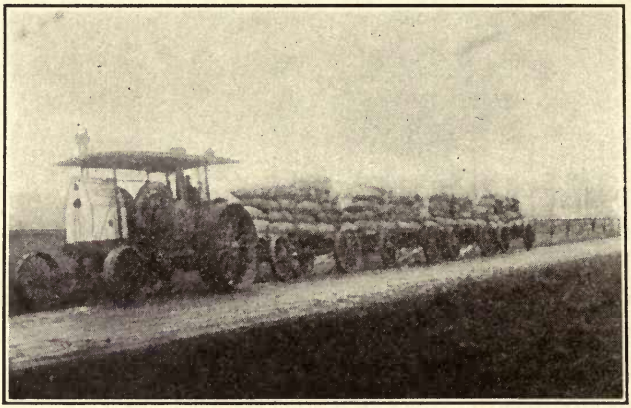
Where a larger acreage is to be grown, instead of spreading the fertilizer by hand, a machine can be used. A broadcast fertilizer drill is quite adaptable for this purpose, or a fertilizer drill placing the fertilizer directly in the spot where the potato is to be grown can be used. Sometimes an attachment to the potato planter is obtainable, and

in this way the fertilizer and a portion of the potato are placed in the ground at the same time.

Cultivation.—Soon after planting or after the first rain, the weeder or smoothing harrow is run over the field and every week at least thereafter until the potatoes are well up. Care is exercised not to injure the young sprouts of the potato by careless handling of these tools. Following the use of the weeder, the cultivator is used between the rows. In later cultivation, the surface of the ground only is stirred. This is highly important, as great injury is often caused by deep cultivation after the potato roots fill the soil. This cultivation is only to form a dust mulch to conserve the moisture in the soil.

As the potatoes do not grow on the low part of the roots, but rather on underground stems which grow on the main stalk just under the surface of the ground, it is good practice when the blossoms appear to slightly hill up the soil around the plants. This will then afford a good place in which the tubers can develop. This would be particularly necessary in soil which has been plowed only 4 inches deep, as the depth of the soil would not be sufficient in which to allow the

potatoes to grow successfully without their pushing out of the soil. The tubers need not only a loose soil in which to enlarge, but it must be so that the air can easily penetrate all through it. The growing tubers must be kept covered with soil to prevent sunburning and having their cooking qualities injured.



Tractor hauling 10½ tons of Potatoes (340 bu.) to car on state road. Maximum grade 7%. Syracuse Gardens Co., Syracuse, N. Y.

Spraying.—The grower has two or more purposes in view when he sprays the growing potato vines. One of these is to kill or drive away the flea beetle, another is to kill the Colorado potato beetle or bug. The flea beetle may be driven off with application of

bordeaux mixture, composed of four pounds of copper sulphate and six pounds of lime to 50 gallons of water. This is especially true if the complete vine is covered with this solution. The Colorado potato bettle can be destroyed by using three pounds arsenate of lead in this bordeaux mixture. The arsenate of lead is a deadly poison.

Another reason for spraying is for the purpose of preventing or controlling the potato blights. Both the early and the late blight are fungous diseases of the leaf and stalk. The late blight appears usually about the middle of July, and it may be present until the vines are killed in early September. It may be detected by a big brownish spot on the leaf and the peculiar odor about the field. For the treatment of these diseases, use the above mentioned bordeaux mixture. The one mentioned is practically safe without testing, sufficient lime being used to counteract any burning of the copper sulphate. It will need from 50 to 75 gallons per acre each application, and eight or more sprayings, the more the better as it is almost invariably that frequent spraying increase the yield of potatoes per acre besides improving their quality for the table.

No part of potato growing seems to be so universally neglected as spraying, and none pays as well for the expense put into it. It costs about a half cent per gallon to make the bordeaux, and with an up-to-date spraying outfit, it will cost about a half cent per gallon to apply. The total cost per acre per application would be from 90 cents to $1. Eight or 10 sprayings would therefore, cost $8 to $10 an acre. As a result of this spraying, it has been found that the crop is increased on the average over 50 bushels an acre. This spray cost is amply reimbursed.

Harvesting and Marketing.—When the tops are dry either from natural ripening of the plant or from having been injured by blight, the potato crop is usually harvested. Sometimes it is allowed to remain in the ground a limited time longer. For table use, the potatoes are left to ripen, because the growth may continue as long as the leaves are in a condition to perform their function. When the potatoes are dug they are left on the ground long enough to dry the outside. Care is exercised, however, that they are not exposed to the strong, hot sun any longer than is necessary to dry the

earth that clings to them; for there is danger that injury may be done.

If potatoes are dug on a clear, dry morning, they may be gathered before noon in a clean condition to go to the cellar. Then, again, all that are dug out in the afternoon need to be picked up and taken care of before night. If it is late in the fall and there is liability of a frost, do not leave any potatoes on the ground over night, for they are quickly injured and spoiled by a very little frost.

If the potatoes are grown for the home, they are placed in the cellar. Precautions are taken against freezing in the cellar, and yet the potatoes are best kept in the cool, dark part of the cellar, protected from the light as well as the frost. Keep them cool to avoid transpiration or evaporation of water, which would cause them to shrivel and grow soft. Potatoes which are properly grown of the medium late, netted skin varieties, should keep in perfection of cooking qualities until June or July of the following season or nearly until the early varieties are ready for use.

If the potatoes are to be sold, they may be taken from the field and run over a screen separating the small ones from the larger

sorts, placed in bags, and disposed of. One of the best methods to date seems to be more care in selecting; that is, grading the potatoes in at least three grades: Extra large potatoes are grouped together and sold as such; medium sizes potatoes grouped and

Spinach 5 weeks from seed; evergreen hedge at the right for a windbreak.
Photo by C. E. Dimon.

sold together; and small potatoes, larger than $1\frac{7}{8}$ inches in diameter but still not in the medium grade are grouped and sold. The last grade is culls, which should be consumed on the farm by feeding to the live stock.

Many restaurants and hotels desire the large type of potato for French fried potatoes and other purposes. The medium sorts are used by the clubs and hotels for individual baked potaoes or boiled potatoes. The small potatoes are used for mashed potatoes mostly, and in some cases in stews and other ways. A high price is often obtained where a grower goes to the expense and trouble of grading the potatoes as mentioned here. Care and attention is given to the proper cleaning of the potatoes by handling them enough to cause the dry soil to drop away.

Many times the medium potatoes, if properly selected through a series of years, can be sold as seed stock, returning from 15 to 25 cents or more above the market price. Those who have tried muck-grown potatoes for seed in upland soils find that they gave a stronger vine and a heavier yield than the upland-grown seed planted in upland soil.

Yield and Cost.—The yield of potatoes on muck is generally large, being from 250 to 400 bushels. The cost of producing them is slightly less than upland costs, being from $85 to $100 an acre. Potatoes for seed bring about $1 a bushel and for market, 50 to 65

cents leaving a net of from $100 to $250. However during certain seasons, as with all crops, the net may be minus, owing to crop failures.

CHAPTER XVIII

SPINACH

Spinach is one of the newer crops on muck soils. However its large yields and high quality have advanced its importance with both the grower, canner and consumer. Two crops a year are easily harvested, as spinach finds its best opportunity for large growth in the rich, cool, constantly moist muck soil. A spring crop of spinach followed by late spinach gives large returns.

Varieties.—All of the varieties of spinach have been tried out on muck. There are four which have survived the tests and fulfilled the growers' ideals. Long Standing probably leads all others, because it "shoots" into blossom only after some time has elapsed, thereby giving ample time for harvesting. Victoria follows in second place, with Giant Thick Leaf and Bloomsdale next.

Preparing.—Plowing, harrowing and planking as mentioned for the other crops, are required by spinach.

Planting.—From 18 to 45 pounds of seed are needed to sow an acre. About 25 pounds is a good seeding. The rows are from 9 to 12 inches apart. Very few growers plant nearer than 9 inches, while average rows are about 12 inches. The seed can be sown with any good seed drill. The drill is set to sow the seed about an inch deep.

Spinach just beginning to grow.

Fertilizer.—If spinach follows a crop of celery either the same year or the following, no fertilizer is needed to obtain a good yield. The same may be said of any other heavily fertilized crop preceding spinach. Where little or no fertilizer has been used on the crop previous, a small application of ferti-

lizer will pay. About 350 to 500 pounds an acre of a mixture containing only phosphoric acid and potash is needed. This mixture preferably contains 4 to 6% phosphoric acid and 6 to 7% potash. Broadcasting the fertilizer is the best practice.

Cultivation.—Tillage is frequent, especially at first, using a shuffle hoe or wheeled hoe and being careful to give only shallow cultivation. Four to six times is the correct number. Spinach should always follow a clean crop, in order to be free from weeds. Therefore, the work of cultivation is generally light.

Pests.—There are no serious insect or disease pests, although at times the leaf maggot or the leaf spot cause loss. There are at present no satisfactory remedies.

Harvesting and Marketing.—Harvesting consists of cutting the stem just at the ground or a little below. The spinach has developed at harvest so that it completely covers the ground. It is, therefore, necessary to use a tool for harvesting that will run under the leaves. A sharp shove-hoe or a sharp-wheeled hoe will work finely. Probably more of the former tools are used.

Two to four rows are cut then raked and forked or lifted by hand into large crates, each crate holding 100 pounds, while some extra large ones contain as much as 500 pounds. In some instances, the spinach is cut by hand, with a large butcher knife. When cut by hand, the spinach is placed in hampers and from these into large crates. The spinach is much cleaner where cut by hand and always returns a higher price.

A crop of Spinach ready to harvest. Yield 12 tons per acre.

The crates are carted to the cannery or packed in the car ready for shipment. Sometimes if muck is located near a good market, spinach may be grown to sell for this nearby

trade. It is then always harvested by hand and packed in hampers or small crates for shipment.

Cost and Yield.—From five to 25 tons from an acre (one crop) has been reported. An average of seven tons per acre (one crop) is good. In 1913, the author saw several pieces of spinach that would run 10 to 12 tons an acre.

The price paid is from $14.50 to $25 a ton. An average of $16 to $18 is very satisfactory most years. One grower in New York State receives $25 a ton.

The cost to grow can be stated as follows:

Plowing, less than ½ day	$2.00
Dragging and planking, 2 hours	1.00
Sowing, 3 hours	.75
Seed, 25 pounds	2.50
Rolling, 1 hour	.25
Cultivating	2.50
Cutting and crating	4.50
Hauling (varies as to distance)	5.00
Total	$18.50

The following are figures from a little over an acre located two miles from the station; sown April 22, harvested June 6. Nine and a quarter loads, averaging 1,538 pounds each, gave 14,166 pounds which at $18 a ton gave a return of $127. Net profit outside of interest depreciation, etc., was $108.69. Re-

turns vary from $80 to $330 or $400 net. A good average return should be $75 net per acre.

Remarks by a Grower.

Remarks by Henry Greffrath of South Lima, N. Y., regarding this crop are most interesting. Mr. Greffrath is one of the most successful all-round muck crop growers in the East.

"We are told that we can grow a better crop of spinach—that is what the canning people tell us—on muck land than any other, for two reasons. It grows very rapidly, and I do not think that the maggot attacks it as much as on sand. But one of the great reasons why canneries prefer Spinach on muck land soil is that there is absolutely no grit in it when canned. That is something they have got to get rid of. Every canner says, 'If I can get it grown on muck, I want it.' If a little of the muck does get into the spinach it is so near the same color you can not detect it, and nobody knows he has it.

"The spinach is usually sold by the hamper in hot weather at high prices. I have known it to sell at $1.25 for a half barrel hamper that we use for shipping lettuce.

There is always a demand for it at canneries, providing you have made arrangements with them beforehand. Last year quite a number of acres were sown, and after it was grown, the canners came and wished to contract it. The first contract was made on the basis of $16 then $18 and some sold at $20 a ton. This is for spinach as cut from the field.

Harvesting spinach. Several rows are cut and raked together. Crates filled by hand.

"The quickest way to harvest is to take a cultivator, with which it is possible to cut two rows at once having one blade run under each row. One man will cut as much as two men can rake. About six rows are raked into a windrow. Then it is placed

into a celery crate and loaded into a car. So the harvesting is very simple and very rapid. About five men will load a car in 10 hours in very good order. We pack our crates just as full as we can providing the distance we have to ship is not very far. Into a celery crate we put close to 100 pounds. A lettuce hamper properly packed for market is supposed to weigh 20 pounds.

"We have shipped spinach as far as Adams, N. Y. The first car shipped there was five days on the road, and it arrived in good condition. But it is not safe to ship to any place that far away. The only thing that made it possible for this car to arrive in good condition was that the day we harvested this spinach the temperature was 32 degrees and the spinach was chilled. They told me heat had not even started in the center of the crate when it arrived. A few days later a similar shipment was made with the temperature at 50 degrees. It made better time, but arrived in bad condition.

"We sow from 15 to 25 pounds of seed an acre according to germination qualities. Last year seed was very poor. Some growers had to sow as high as 40 pounds an acre. It is very important to know just what per-

cent of your seed will grow. Seeds should be tested. Why run the risk of not having a good stand? I always make a practice of knowing just what percent of my seed I have reason to expect will produce a sound, strong, healthy plant. We sow in rows 8, 10 and 12 inches apart, which is plenty close enough. Some say we can grow it as close as 8 inches. Some even say sow broadcast but it does better when cultivated.

"There are several kinds of spinach. Some will go to seed much more quickly than others. This year we are going to try to grow two crops on the same lands. We are going to sow one crop extremely early and have it come into the market before peas, then follow with one crop which would come late in the fall. For this there is always a wide market. A good many times I have seen good spinach grown after onions.

"Last year I produced spinach on a piece of land on which I had harvested early celery about the middle of July. I sold from that bed $180 worth of spinach after having received a very fine crop of celery. It made a very nice second crop.

"The size of the plot was an acre and an eighth. That is the size of all my beds. As

high as 11 tons per acre have been grown by weight at South Lima. We will say an average yield of spinach would be seven tons on good land. I do not believe it is possible for any man to grow spinach on new muck land. The land must be well subdued and clean. If you have chickweed, do not try spinach. Several acres of ground at South Lima sown to spinach came up so thick with chickweed that the canneries rejected it. You cannot sort it out.

"All the labor a grower can afford to put on it is what he can with a wheeled hoe. It is safe to say that, under ordinary conditions, $25 an acre should furnish the seed, prepare the ground, and harvest the crop. The average yield I should estimate at seven tons. We have contracted for $18 a ton, and the canner furnishes all packages and pays freight each way.

"The Long Standing we find the best of any variety to sow if we want to carry it along. We are going to sow all our spinach at one time. We told the party we contracted with, we should sow Round Thick Leaf, Victory and Long Standing. There is not much difference in Long Season and Long Standing. Norfolk Savoy is an excel-

lent spinach to sow in the fall, but we do not sow it in the spring. It runs to seed very rapidly. In the fall I think it is one of the best.

"We do not use any fertilizer at all, but put the spinach on ground highly fertilized for celery. If I were going to start it in the spring, I might give it some amount below 500 pounds an acre. I believe that we are using as much fertilizer at South Lima as is used in any section where they are growing truck. On my early celery I do not use less than 3,500 pounds an acre. That is for celery grown in double rows 3 feet apart, center to center, double row system requiring about 60,000 plants an acre. I find I can get quicker results by using a large amount of fertilizer. The earlier I can get it the more money I can get from it. We can grow a crop of late celery with 500 pounds an acre."

CHAPTER XIX

MISCELLANEOUS CROPS

Many other crops are grown on muck but generally only in a limited way. A short sketch will be given of several minor crops, in order to show the possibilities yet unused for money-making if a grower has a bit of muck on the farm.

STRAWBERRIES

A. B. Katkamier of Farmington, N. Y., has had some very good experience with plant production. He says, "My experience convinces me that strawberry plants grown on muck are far superior to upland plants to use in setting out upland fields for fruiting purposes. Each year there are hundreds of acres devoted to growing strawberry plants to be used only for setting out new plantations. I believe berry growers can well afford to pay 50 cents or $1, even more per 1,000 for muck-grown plants than for upland-grown plants. The muck plants have a much better root system and a larger crown.

They seem to start growing quicker and grow faster, taking on a better color than upland plants. For several years, I have tested muck and upland plants side by side, and the difference is very marked in favor of the muck plants."

Giant Squashes, largest 117 lbs. Average 22.4 tons per acre. Grown on muck of Syracuse Gardens Co., Syracuse, N. Y.

Just a word about this, and a word of caution. Have the muck very well drained. Do no have any standing water at any time over the plants, otherwise you will fail.

SQUASH

By growing the plants under protection early and transplanting after all danger of frost is over, very fine squash can be obtained. Squash grown by Italians on the ditch banks from seed planted July 1, gave very fine squash of good size, but they were so late the frost caught them all.

NARCISSI

Raised bulbs of Narcissi is decidedly new. However, W. H. Ellis of South Lima (one of the finest lettuce specialists in the country) has succeeded in obtaining most excellent bulbs of large size. The amount and size of both leaves and flowers is much improved by growing on muck.

ASTERS

Asters seem to be right at home on muck. The foliage is generally much larger than when grown on upland also the blooms are much improved in size. Care is exercised to have the plants for transplant quite early in the season, in order to insure a crop of blooms before frost.

CELERIAC

Root or knot celery can be grown somewhat similarly to celery, except that it needs

no blanching. Where a grower is located quite near a large city, it would be a profitable crop to grow.

OATS AND OTHER GRAINS

All grains can be grown on muck. However, applications of phosphoric acid and potash will be necessary, in order to obtain a good crop. Lack of these two elements means deficient grain and lack of potash means weak straw subject to lodging. About 200 to 300 pounds of a mixture containing 6% phosphoric acid and 4% potash is good. Methods of culture are the same as for upland crops.

HAY

Seeding down of hay can take place the last of July. If the muck is at all acid, it is given an application of lime, either (1) two to three tons of ground limestone per acre, or (2) one and a half tons of air-slaked lime per acre or (3) two tons of marl per acre. Spread the lime directly on the furrows after plowing and harrow it in.

A good fertilizer to use is a bone-base mixture made up of 500 pounds nitrate of soda, 1,000 pounds ground bone, and 500 pounds muriate of potash, using about 500 to 700

pounds an acre at the time of seeding. For a seed mixture, a good combination is eight pounds of timothy, eight pounds medium red clover, six pounds alsike clover and four pounds of red top, using the mixture at the rate of 12 pounds an acre.

The following spring after the grass has reached a height of 2 or 3 inches a top dressing of 250 to 300 pounds of the following mixture is advisably used: 1,000 pounds nitrate of soda, 500 pounds ground bone, 200 pounds acid phosphate and 300 pounds muriate of potash.

About a week after cutting the first crop, about 150 pounds of this last mixture are used to encourage a second growth, thereby giving two cuttings a year. The last mentioned spring and supplementary applications may be given each year as long as there is a good stand of grass. Probably after three years it would be better to plow up and either reseed or plant to other crops. Reliming would generally take place only every fifth year.

INDEX

PAGE

A

Acreage of muck 10
Analysis of muck 19
Analysis of soils 31
Arkport burns 37
Asparagus 77–82
  Requirements 77
  Varieties 77
  Seedlings 78
  Planting 79
  The natural position for the growth of the roots 79
  Care following planting 79
  Fertilizer 80
  Harvesting and marketing 80
  Yields, costs, and returns 82
Asters 244

B

Beets 83–87
  Garden 82
  Requirements 82
  Varieties 82
  Preparing soil 82
  Planting 82
  Care of crop—fertilizer 83
  Harvesting 85
  Marketing and yields 86
  Cow beets or mangel wurzels, requirements and culture 86
Blanching early celery 136
Blanching late celery 147
Blight late, celery 126
Boards for blanching celery 136
Bonney & Ware 62–200
Bordeaux mixture for celery 228
Bordeaux mixture for potatoes 225

C

Cabbage 88–96

PAGE

Requirements 88
Varieties 88
Preparing the muck 89
Planting 89
Fertilizers 90
Care during the season 92
Insects and diseases 92
Harvesting and marketing 94
Yields, costs and returns 95
Canastota basket 150–173
Canning (Harvesting peas for) 211
Care of beets 84
Care of cabbage 92
Carrots 97–102
Requirements 97
Varieties 98
Preparing the muck 98
Planting 98
Fertilizers 99
Cultivation 99
Insects and diseases 100
Harvesting 100
Marketing 100
Storage 101
Yields, costs and returns 101
Care of asparagus 79
Cauliflower 103–110
Requirements 103
Varieties 103
Seed 104
Growing and plants 104
Preparing and planting 105
Fertilizer 106
Cultivation 107
Insects and diseases 108
Harvesting 108
Marketing 109
Yields, costs and returns 110
Celeriac 244
Celery 39
Celery, early 111–141
Requirements 111
How to start the plants 112
Transplanting to field 117
Marking out the rows 117
Fertilizers 119
Cultivation 122

PAGE

Mulching 123
Irrigation—different forms 123
Diseases and spraying 126
Insects 135
Blanching 136
Harvesting and marketing 138
Cost of raising an acre 141
Celery, late 142–156
Requirements 142
Growing the plants 142
Transplanting to the field 142
Planting 143
Fertilizer 144
Cultivation 146
Irrigation 146
Insects, diseases and spraying 146
Blanching 147
Harvesting 149
Storing 152
Cost to grow 153
A good celery farm 153
Celery farm 153
Chemical contents 10
Clearing 42
Comparison of muck and other soils . . . 29
Companion crops 167
Commercial (Harvesting Peas for) . . . 212
Contracting of muck 9
Corn 157
Requirements 157–163
Sweet corn 157
Remarks 157
Varieties 157
Seed 158
Preparing the soil 158
Planting 158
Fertilizer 159
Cultivation 159
Suckering 160
Insects and diseases 160
Harvesting and marketing 161
Yields and costs 161
Field corn 163
General requirements 163
Corn field 163
Corn sweet 157
Cost of main ditches 49

PAGE

Cost of asparagus 82
Cost of onions 198
Cost of potatoes 229
Cost of peas 214
Cost of spinach 235
Cost of lettuce 176
Cost of sweet corn 159
Cost of late celery 153
Cost of early celery 141
Cost of carrots 101
Cost of spraying 132
Cost of cabbage 95
Cost of cauliflower 107
Cost of beets 86
Cropping soil 37–40
Crops, first 75
Cultivating carrots 99
Cultivating cauliflower 107
Cultivating early celery 122
Cultivating late celery 146
Cultivating hay 246
Cultivating sweet corn 159
Cultivating lettuce 168
Cultivating mint 181
Cultivating onions 191
Cultivating peas 210
Cultivating potatoes 223
Cultivating spinach 233

D

Davis 23
Decay of muck 4
Diseases of cabbage 93
Diseases of carrots 100
Diseases of cauliflower 108
Diseases of early celery 126–134
Diseases of lettuce 170
Diseases of onions 204
Diseases of peas 216
Diseases of potatoes 225
Diseases of spinach 233
Diseases of sweet corn 160
Distilling mint 182
Draining 43

F

Fertilizer for asparagus 80

PAGE

Fertilizer for beets 84
Fertilizer for cabbage 90
Fertilizer for carrots 99
Fertilizer for cauliflower 106
Fertilizer for early celery 119
Fertilizer for grains 245
Fertilizer for hay 246
Fertilizer for lettuce 165
Fertilizer for late celery 144
Fertilizer for mint 181
Fertilizer for onions 189
Fertilizer for peas 209
Fertilizer for potatoes 221
Fertilizer for spinach 232–241
Fertilizer for sweet corn 159
Fertilizer, value of muck 24–32
Field corn 163
Fitting seed bed 73
First crops 75
Fuel value 22

G

Good vs. poor muck 3
Grains 245
Greffrath, Henry 236
Growing cauliflower plants 104
Growing early celery plants 112
Growing late celery plants 142

H

Hay 245
Harvesting asparagus 80
Harvesting beets 85
Harvesting cabbage 94
Harvesting carrots 100
Harvesting cauliflower 108
Harvesting early celery 138
Harvesting hay 246
Harvesting late celery 149
Harvesting lettuce 172
Harvesting mint 182
Harvesting peas 211
Harvesting potatoes 226
Harvesting spinach 233
Harvesting sweet corn 161
Hull Brothers celery 120

PAGE

I

Insects on cabbage 92
Insects on carrots 100
Insects on cauliflower 108
Insects on early celery 123
Insects on sweet corn 160
Insects on lettuce 168
Insects on onions 201
Insects on peas 214
Insects on potatoes 224
Insects on spinach 233
Irrigating early celery 123
Irrigation late celery 146
Irrigation lettuce 168

K

Katkamier, A. B. 242

L

Lettuce 164–178
Requirements 164
Varieties 164
Preparing land 165
Fertilizer 165
Planting 165
Cultivation 166
Thinning 169
Irrigation 168
Insects 170
Diseases 170
Harvesting and marketing 172
Shipping 175
Costs, yields and results 176
Level using 164

M

Machines spray 130
Mangel wurzels 86
Marketing asparagus 80
Marketing beets 86
Marketing cabbage 94
Marketing carrots 100
Marketing cauliflower 109
Marketing early celery 138
Marketing sweet corn 161
Marketing late celery 152
Marketing lettuce 172
Marketing onions 196

PAGE

Marketing potatoes 226
Marketing spinach 233–238
Marking rows, early celery 117
Mineral matter in muck 11
Miscellaneous crops 242–246
  Remarks 242
  Strawberries 242
  Squash 244
  Narcissi 244
  Asters 244
  Oats and other grains 245
  Hay 246
Mint 179–183
  Remarks 179
  Preparing and planting 179
  Fertilizer 181
  Cultivation 181
  Harvesting and distilling 182
  Yields 182
Muck 1
  What is 1
  How formed 1
  Good vs. poor 3
  Stages of decay 4
  Shallow vs. deep 6
  Substratum 6
  Water holding capacity 8
  Chemical contents 10
  Muck like substances 13
  Where found 15
  Cicero muck 17
  South Lima 18
  Acreage of 19
  Value of 20
  Reclaiming 41
  Miscellaneous crops 242
Muck like substances 13
Muck shoes 69
Mulching early celery 123

N

Narcissi 244

O

Oats 245
Overhead irrigation 125
Onions 184–207

PAGE

Requirements 184
Varieties 185
Preparation of the land 186
Planting 187
Fertilizer 188
Cultivation 191
Weeding 191
Pulling 192
Topping 193
Stacking 195
Screening 195
Marketing 196
Storage 197
Costs 198
Yields 200
Insects 201
Diseases 204
Smut 205
Typical onion farm 206
Onion farm, typical 206
Onion smut remedy 205

P

Paper for blanching celery 136
Peas 208–217
Requirements 208
Varieties 208
Fertilizers 209
Preparing and planting 209
Cultivation 210
Harvesting 211
Cannery 211
Commercial 212
Yields 213
Insects 214
Diseases 216
Planting asparagus 79
Planting beets 83
Planting cabbage 89
Planting carrots 98
Planting cauliflower 105
Planting lettuce 166
Planting mint 180
Planting onions 187
Pulling onions 192
Planting peas 209
Planting potatoes 220

PAGE

Planting spinach 232–237
Planting sweet corn 158
Plowing 68–69–83–98
Potatoes 218–230
Requirements 218
Varieties 218
Seed 219
Preparing for planting 219
Planting 220
Fertilizers 220
Cultivation 220
Spraying 223
Harvesting, marketing 224
Yields and costs 229
Pre-cooling lettuce 177
Preparing soil for lettuce 165
Preparing soil for mint 179
Preparing soil for onions 186
Preparing soil for peas 209
Preparing soil for potatoes 219
Preparing soil for spinach 231–239
Profits from spraying 133

R

Reclaiming 41

S

Screening onions 195
Seed bed 73
Seed bed early celery 112
Seed of cauliflower 104
Seed potatoes 219
Seedlings asparagus 78
Shallow vs. deep muck 6
Shipping lettuce 174–175
Soil restorer 29
Sources of water 48
South Lima 236
Spinach 231
Requirements 231
Varieties 231
Preparing 231
Planting 232
Fertilizer 232
Cultivation 233
Pests 233
Harvesting and marketing 233

PAGE

Costs and yields 235
Remarks by grower 236
Spinach facts 236
Spraying conclusion 134
Spraying costs 132
Spraying late celery 146
Spraying early celery 126–128
Spraying potatoes 224
Spraying profits 133
Spraying machines 130
Squash 244
Stable absorbent 28
Stacking onions 195
Storage 101
Storing late celery 152
Storing onions 197
Strawberries 242
Suckering sweet corn 160
Sub-irrigation 124
Substratum 6
Sweet corn 157

T

Thinning lettuce 169
Tile 53–54–56
Tile examples 55
Tile irrigation 124
Todd Co., A. M. 37–153–179–206
Topping onions 193
Transplanting early celery 117
Transplanting late celery 142
Typical swamps 17

V

Value as coke, etc. 24
Value as cropping soil 37
Value as fertilizer 25–34
Value as fuel 22
Value of muck 20
Varieties of asparagus 77
Varieties of beets 83
Varieties of cabbage 88
Varieties of carrots 98
Varieties of cauliflower 103
Varieties of lettuce 164
Varieties of onions 185
Varieties of peas 208

PAGE
Varieties of potatoes 218
Varieties of spinach 231–239
Varieties of sweet corn 157

W

Water holding capacity of muck 8
Weeding onions 191
Where is muck found 15
Windbreaks 75–97

Y

Yields of asparagus 82
Yields of oats 86
Yields of cabbage 95
Yields of carrots 101
Yields of cauliflower 110
Yields of early celery 141
Yields of late celery 153
Yields of lettuce 176
Yields of mint 182
Yields of onions 200
Yields of peas 213
Yields of potatoes 229
Yields of spinach 235
Yields of sweet corn 161

14 DAY USE
RETURN TO DESK FROM WHICH BORROWED

LOAN DEPT.

This book is due on the last date stamped below, or on the date to which renewed. Renewals only: Tel. No. 642-3405
Renewals may be made 4 days priod to date due.
Renewed books are subject to immediate recall.

NOV 24 1970 08

REC'D LD NOV 10 70 -4 PM 2 5

MAY 1 8 2002

LD21A–60m-8,'70
(N8837s10)476—A-32

General Library
University of California
Berkeley

YB 47524

SB321
W7

393730

UNIVERSITY OF CALIFORNIA LIBRARY